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Practical and Theoretical Mechanics and Chemistry.

On Hydraulic and Common Mortars. By General TREUSSART, *Inspecteur du Génie. Translated from the French by J. G. Totten, Lt. Col. of Eng. and Brevet Col. United States Army.*

(CONTINUED FROM P. 323.)

ART. IV. *Of Artificial Hydraulic Limes.*

I stated in the first article, that, for a long time, the property possessed by certain limes of hardening in water, was attributed to the presence of oxides of manganese and of iron; several very hydraulic limestones were, however, at last found that contained no oxide of manganese and very little iron. It was observed, at a later period, that almost all hydraulic limestone contained from one to three-tenths of clay. This led to the opinion that when a certain proportion of clay is disseminated in limestone, it combines, by calcination, with the lime, and imparts to it the property of hardening in water. I stated that Mr. Vicat, Engineer of roads and bridges, published, in 1818, an interesting memoir on hydraulic mortars, and that he announced that by reburning fat lime with a certain quality of clay, he obtained very good hydraulic lime. I was bound to state, also, that Dr. John, of Berlin, presented to the Society of Sciences of Holland, a memoir on the subject which was crowned in 1818, and published the following year. He gave the analysis of many common, and hydraulic limes, as well as of many ancient mortars, and he showed that the hydraulic proper-

ty of lime is due to a portion of clay which combines with it by calcination, and he calls this clay the *cement* of the lime.

The Minister of War sent the memoir of Mr. Vicat to those places where public works were in progress, and directed the experiments announced by this Engineer, to be repeated. I was then occupied at Strasburg, in rebuilding the sluices and other badly constructed hydraulic works; and was using the Obernai hydraulic lime. I had caused trass to be brought from Andernach, having had occasion to employ it at the great works of Vésel in 1806, 1807 and 1808, and knowing its excellence in constructions under water. In the erection of the sluices at Strasburg, we composed the mortar of the Obernai hydraulic lime, sand and trass; but this last substance being dear, I had begun making some essays towards replacing it with cement, when the memoir of Mr. Vicat was sent to me. I caused the experiments given in that work to be repeated, in the first place by an officer of Engineers, who used a clay of which bricks are made in the environs of Strasburg: he obtained no satisfactory result. A second officer was directed to recommence the experiments, and he was not more successful than the first. I repeated them, then, myself, and I took great pains in making the mixture of clay and lime; they were then calcined and I obtained a result, but it was a very feeble one. I then began anew, using other argillaceous earths, richer in clay, (*plus grasses*) and I got much better results. The mortars made with these artificial hydraulic limes, are shown in the following table.

TABLE No. IX.

No. of the mortar.	Composition of the mortar.		No. of days required to harden in water.	Weights supported before breaking.
			days	lbs.
1	Fat lime, reburnt with 2-10 of brick earth, slaked to powder and measured in powder	1	28	44
	Sand	2 } 3		
2	Same lime, reburnt with 1-10 of Holsheim clay	1	30	106
	Sand	2 } 3		
3	Same Lime, reburnt with 2-10 of Holsheim clay	1	20	187
	Sand	2 } 3		
4	Same lime, reburnt with 3-10 of Holsheim clay	1		—22
	Sand	2 } 3		
5	Lime from white marble, reburnt with 1-10 of Holsheim clay	1	35	55
	Sand	2 } 3		
6	Same lime reburnt with 2-10 of Holsheim clay	1	27	174
	Sand	2 } 3		
7	Same lime, reburnt with 3-10 of Holsheim clay	1	36	130
	Sand	2 } 3		
8	Fat lime reburnt with 2-10 of pipe clay measured in paste	1	10	132
	Sand	2 } 3		
9	Same lime reburnt with 2-10 of Holsheim clay do.	1	10	216
	Sand	2 } 3		

Table No. IX.—(Continued.)

No. of the mortar.	Composition of the mortar.		No. of days required to harden in water.	Weights supported before breaking.
			days	l s.
10	Same lime reburnt with 2-10 of Yellow Ochre do.	1	15	90
	Sand	2 3		
11	Same lime, reburnt with 2-10 of "*Sanguine*" do	1	25	44
	Sand	2 3		
12	Same lime reburnt with 2-10 of Sufflenheim clay do.	1	17	110
	Sand	2 3		
13	Same lime reburnt with 2-10 of Frankfort clay do.	1	17	121
	Sand	2 3		
14	Same lime reburnt with 2-10 of pipe clay, but more highly calcined than the lime of No. 8	1	16	197
	Sand	2 3		
15	Fat lime reburnt with 2-10 pipe clay, measured in paste	1	5	307
	Trass	2 3		
16	Lime from white marble, reburnt with 2-10 of alumine do.	1		
	Sand	2 3		
17	Same lime reburnt with 1-10 of alumine and 1-10 of white sand do.	1		
	Sand	2 3		
18	Same lime reburnt with 2-10 of white sand pulverized do.	1		
	Sand	2 3		
19	Fat lime reburnt with 2-10 of white sand pulverized do.	1	21	51
	Sand	2 3		
20	Same lime reburnt with 2-10 of common sand pulverized do.	1	28	35
	Sand	2 3		
21	Same lime reburnt with 2-10 of magnesia do.	1		
	Sand	2 3		
22	Same lime reburnt with several proportions of oxide of manganese do.	1		
	Sand	2 3		
23	Same lime reburnt with several proportions of iron filings, and with oxide of iron in several states of oxidation	1		
	Sand	2 3		

Observations on the experiments of Table No. IX.

The hydraulic limes of this table were made by the process of Mr. Vicat: care being taken to temper the clays in water, and to make the mixture when they were reduced to the consistence of a homogeneous sirup.

If the clays be not diluted, the union with the lime cannot be so well made. The compound of lime and clay was made by taking one part of lime measured in paste, and the several proportions of clay mentioned in the table. All the limes were reburnt by placing them in Hessian crucibles, in the middle of the lime kiln; there was no exception but No. 14, which, as will be stated below, was more strongly calcined than the other limes. All the mortars were made as soon as the artificial limes were withdrawn from the kilns. The proportion of the first seven mortars was got by taking one part of lime in powder to two parts of sand. Some experiments having shown me that in this mixture there was too much sand, the mortars from No. 8 to No. 23 were made by taking one part of lime in paste to two parts of sand.

No. 1 consists of fat lime reburnt with $\frac{2}{10}$ of brick-earth of the environs of Strasburg: this did not give a good result, as may be seen in the last column.

Nos. 2, 3 and 4 were intended as a trial of the clay of the Village of Holsheim, near Strasburg. Lime was mixed, successively, with 1, 2 and 3 tenths of that clay: it will be seen that the best result was with $\frac{2}{10}$; the mixture in which there was $\frac{3}{10}$ of clay gave a mortar which did not bear the scale pan, and broke easily in the fingers. The Holsheim clay is reddish, and greasy to the touch. Further on, I will give its composition.

Nos. 5, 6 and 7 are a repetition of the three preceding experiments, with this difference—that lime made from white marble was employed, instead of the fat lime of the country. The greatest resistance that I obtained with this lime was in a mixture with $\frac{2}{10}$ of clay. It is remarkable that with $\frac{3}{10}$ of clay, I obtained a passable result, while in No. 4, with the same proportion of clay, and differing from No. 7 only in the kind of lime, the result was very bad. I do not know to what this can be owing.

No. 8 was made with a greasy and very white clay, brought from the neighborhood of Cologne, to Strasburg, to make pipes. This clay gave a tolerable result.

No. 9 is a repetition of No. 3: there is no difference except in the proportions. No. 3 was made by taking one part of lime when reduced to powder after the second burning, and two parts of sand, while for No. 9 one part of lime, when reduced to paste after the second burning, was taken, to two parts of sand: as there is more lime in a given bulk of paste than in an equal bulk of powder, this mortar contained less sand than No. 3, and it gave a better result. It may be seen by Tables No. II and III that the natural hydraulic limes of the environs of Strasburg, will not bear a large proportion of sand; and I think that, in general, hydraulic lime takes less than is commonly supposed.

No. 10 was made with the yellow ochre of commerce, and No. 11, with a substance known under the name of *sanguine:* the results were weak, especially No. 11.

No. 12 was made with the Sufflenheim earth, which is used in making refractory bricks that are highly esteemed in the country, and employed at the cannon foundry at Strasburg. No. 13 contained clay which is brought, because of its containing little or no iron, from the neighborhood of Frankfort, to Strasburg, to make alum. The results of these two trials are not very satisfactory.

No. 14 was made in the same manner, and same proportions as No 8;

it differs from it only in the lime being more highly calcined. The result was better. It is possible that each kind of clay requires a particular degree of calcination; this result may be owing also to this—that the lime and the clay contain very little iron, which appears to facilitate vitrification.

The lime of No. 15 was calcined like that of No. 8: but in lieu of making the mortar of sand, it was made of trass: the result was much superior.

No. 16 was made with $\frac{2}{10}$ of alumine mixed with lime from white marble. There was no result: the mortars had no sort of consistence.

No 17 was composed of lime from white marble, mixed with a factitious clay composed of equal parts of silex pounded very fine, and of alumine: this gave a better result. The bad result of No. 16 induced me, at first, to conclude that alumine alone had not the property of rendering lime hydraulic: but a mixture of silecious sand and alumine not having yielded a better result, although forming a factitious clay, I have thought it might be owing to the following circumstance: the alumine which I used was extracted from a quality of alum that I decomposed; this alum had been made of the Frankfort clay, of which I will give the analysis below. In making the alum, the clay is calcined before being dissolved in sulphuric acid. It is possible that the calcination takes away from the alumine the property of combining with lime in the dry way. We ought not, therefore, to conclude, from No. 16, that alumine has not the property of rendering lime hydraulic, but only, that, when it has been calcined, it has not that property. What makes me think that calcination deprived the alumine of the property of combining in the dry way with the lime, is, that I have calcined one part of fat lime with $\frac{2}{10}$ of puzzalona, without getting any result. To know if alumine has the property of rendering lime hydraulic, it will be necessary to use this substance before it has been calcined, or acted upon by any acid. Pure alumine exists in some countries: but it is rare: I had none at command.

Nos. 18 and 19 are, respectively, mixtures of marble lime and fat lime, with white sand, and common sand broken very fine. It is remarkable that I obtained a result with fat lime, and no result with the marble lime. I do not know to what to attribute this difference: it may happen perhaps in this way, that the fat lime, of which I shall give the analysis below, contains the red oxide of iron which might facilitate the union of the lime with the white sand, which is entirely silecious.

No. 20, made with fat lime, and with ordinary sand, which is granitic, and coloured by the red oxide of iron, gave a result nearly like No. 9. I regret not having made a fourth experiment with marble lime and ordinary sand, in order to prove, further, that oxide of iron facilitates the combination of silecious and granitic sands with lime, as appears to be inferable from a comparison of Nos. 18 and 19.

No. 21 was designed to ascertain the influence of magnesia: that which I used in this experiment had been calcined to disengage the carbonic acid. We see that no result was obtained. I repeated the experiments, using carbonate of magnesia in order to avoid the use of a substance which had already been calcined: the heat of the lime kiln would drive off the carbonic acid of the magnesia, so that the magnesia would be free to combine with the lime; I, however, got no result.

No. 22 was an attempt to ascertain whether manganese imparted any properties to the lime. I mixed, successively, one part of fat lime with

one, two, and three tenths, of oxide of manganese, and calcined the mixtures: I did not observe that the lime had undergone the least change. It is quite astonishing that an opinion should have prevailed for so long a time, that it was to oxide of manganese, hydraulic lime owed its quality of hardening in water: mixing fat lime with this oxide would have shown that lime acquires no new property thereby.

No. 23 indicates that I made various experiments with iron. I took one part of fat lime, which I mixed successively with diverse proportions of filings of iron obtained from a locksmith's shop, and which I reduced to very fine powder. I did the same thing with black oxide of iron, with brown oxide at different degrees of oxidation, and with steel filings: all these mixtures were burned in a lime kiln and I then made mortars by uniting them with sand; the lime had acquired no hydraulic property; but I had occasion to remark that the oxide of iron had, nevertheless, a marked action on the lime. It is known that if we take lime made of white marble, and throw water on it as it comes from the kiln, it slakes at once, giving out much heat and vapour. In making the above experiments with iron, I remarked, that the higher it was oxidized the less heat and vapour were given out by the lime on throwing water upon it, and that it did not slake until after it had been wet for some time: the lime which had been calcined with $\frac{3}{10}$ of brown oxide of iron gave no vapour; I placed in it a thermometer of Reaumur, and at the end of half an hour it had risen but five or six degrees. The Boulogne pebbles contain, as I have observed, a considerable quantity of brown oxide of iron; it is owing to this, no doubt, that if water be thrown on these pebbles as they are taken from the kiln, they give very little heat and no vapour: they do not fall to powder, and must be reduced to that state by pounding. The fat lime of Strasburg, also, contains a certain quantity of brown oxide of iron; the limestone has rusty stains in many places: when water is thrown on it, after calcination, some time is required for it to begin to slake.

A great part of the clays used in the above table were analysed, under the direction of Mr. Berthier, at the school of mines. I give, below, the substances they contain; and also the analysis of the fat limestone of the neighborhood of Strasburg. This stone contains the following substances, viz: carbonate of lime, 0.964; oxide of iron, 0.020; water and loss 0.016. We see that after calcination, which drives off the water and the carbonic acid, there is left lime mixed with about two per cent of oxide of iron.

The following is the analysis made by Mr. Berthier of the different clays used by me.

	CLAYS FROM					
	Holsheim.	Vissembourg.	Frankfort.	Cologne.	Sufflenheim.	Kalbsheim.
Silex	0.430	0.687	0.500	0.670	0.724	0.442
Sand, Quartzose, mixed	0.365	0.015				0.010
Alumine	0.095	0.182	0.327	0.240	0.118	0.112
Magnesia	0.014	0.006	0.015	0.012	0.020	0.020
Oxide of iron	0.030	0.016	trace	0.012	0.048	0.048
Lime						0.164
Water*	0.056	0.092	0.160	0.066	0.078	0.202
	0.990	0.998	1.002	1.000	0.988	0.998

* The number 0.202 comprises carbonic acid and water. Au.

I used in my experiments two kinds of sand. That which I have designated as white sand is silecious, and is used in making crystals at the manufactory of Saint Louis in the Vosges: it is fine, and very white. The sand which has no particular designation given it in the tables, and which I have sometimes called ordinary sand to distinguish it from the white sand, is that which is commonly used at the works in Strasburg: it is obtained from a plain to the south-east of the town, between the Rhine and the Ill. This sand is rather fine; small gravel is mixed with it, and it is, a very little, earthy; it is coloured quite red by the oxide of iron. This is, for the greater part, granitic, mixed with a little silex.

The above experiments, with iron and oxide of manganese, confirm the opinion now for some time entertained, that these two metals do not confer any hydraulic property on lime. These results were published in 1822, as well as those concerning silex. At the same period, Mr. Berthier published in Vol. VII of the *Annales des Mines*, several interesting experiments, which I shall state. This Engineer, also, having ascertained that iron, and oxide of manganese, imparted no hydraulic quality to lime, says—

"Various mixtures, of chalk and ordinary sand, having been burned in a lime kiln, we obtained only meagre lime not hydraulic, and it was ascertained that only the twentieth part of the sand had been attached and rendered soluble by the alkalis.

"By substituting, for ordinary sand, the sand of Aumont, prepared for the manufacture of the Sévres porcelain, that is to say, reduced to powder by grinding, the combination is better; but all the silecious matter was not yet attached, and there remained about one third, which could not be dissolved in alkalis. We afterwards calcined for about one hour, in a platina crucible, at the temperature of about fifty pyrometric degrees, a mixture of ten grammes of chalk and one fifth of gelatinous silex, that is to say, silex separated by acids from its solution in alkalis. The matter slaked with considerable heat, and swelled a little: it formed a consistent paste with water, and, after two months immersion, the paste had acquired strength enough to resist the impression of the finger.

"We calcined, in a platina crucible, ten grammes of chalk with quantities of hydrate of alumine corresponding to 1.942 grammes in one experiment; and 2.36 grammes, in the other: the two mixtures slaked promptly with a strong heat, and swelled considerably. Soft pastes were made of these and put under water: but at the end of two months they had not acquired the least consistence.

"Ten grammes of the magnesian carbonate (of lime) of Paris, and two grammes of gelatinous silex, gave a lime which slaked with feeble heat and little swelling, and after a very short immersion became harder than the best artificial hydraulic lime. This lime may be stated to be composed of lime, 0.560; magnesia, 0.166; silex, 0.274.

"An essay made on a large scale with four parts of chalk, and one part of the kaolin of Limoges, induces the belief that it will be advantageous to have the quantity of alumine equal to the quantity of silex. This lime must be considered as composed of lime, 0.745; alumine, 0.125 ;and silex, 0.130; it acquired, very soon after its immersion, a consistence stronger than that of the artificial lime prepared with four parts of chalk, and one part of the Passy clay.

"A lime prepared, on a large scale, with four parts of chalk and one part of yellow ochre (in volume,) and which should contain lime, 0.745;

alumine, 0.055; oxide of iron, 0.070; silex, 0.130, took but a feeble consistence, even after being immersed a long time. We cannot help attributing the bad quality of this lime to the oxide of iron, because with a quantity of clay equal to the quantity of ochre used, we always obtain a lime eminently hydraulic.

"We calcined, in a platina crucible, ten grammes of chalk, 2.50 of carbonate of magnesia, and 2.50 of gelatinous silex. The matter was purplish; it slaked, giving out heat. A paste was made of it which was placed in water: at the end of two months it had acquired no consistence, while the chalk and silex alone, would have given a lime hardening promptly."

Mr. Berthier thinks that no mixture of which silex does not form a part, will acquire hydraulic properties: that appears probable; but, to be able to affirm it positively, it would be necessary to heat mixtures of lime and alumine or magnesia, which had not already sustained a first calcination. Mr. Berthier does not say whether the alumine which he mixed with his lime was derived from the decomposition of alum, or was natural alumine. In the first case, it is probable it had already sustained a previous calcination, and if so, it is not surprising that no result was obtained.

Mr. Berthier concludes from the experiment which he made with four parts of chalk and one part of ochre, that the oxide of iron was injurious. The oxide of iron enters, however, only in the small quantity of 0.070; and according to the analysis he gives of the English stone, (which furnishes Parker's cement?) it exists therein to the extent of 0.086, and, in the Boulogne pebbles, to the extent of 0.150; this last quantity being more than double, and these two limes being very hydraulic, notwithstanding.

We see that the experiments of Mr. Berthier and mine accord, as to hardening. The learned Professor did not submit his specimens to pressure, to ascertain the tenacity; it is probable he would have had results analogous to mine. I made no experiments by combining, as Mr. Berthier did, carbonate of magnesia with silex, which produced a lime hardening very promptly. It is desirable to repeat this experiment; afterwards submitting the mortars to pressure, to learn their tenacity.

A part of my preceding experiments having been printed in 1824 in a small pamphlet which was sent to the public works, and was inserted in the seventh number of the *Mémorial de l'Officier du Génie*, Mr. Vicat published, in the *Bulletin des Sciences*, in 1825, and in the *Annales des Mines*, Vol. X, 3d livraison, page 501, some observations on the results that I had presented. I propose answering the observations of Mr. Vicat, as the more suitable occasions present themselves. This Engineer commences his remarks in the following manner: "In proscribing hydraulic limes, Mr. Treussart rests upon experiments which do not appear to be conclusive: in the mixtures he made, sometimes he did not employ the clay in suitable proportions, sometimes he used a clay too aluminous, or charged with too great a quantity of oxide of iron, and sometimes he used quartz pounded very fine, as if the degree of fineness obtained by simple trituration could be compared to that of the silex contained in clay."

I do not know what induced Mr. Vicat to say that I proscribed hydraulic lime; the following are the expressions which conclude the pamphlet in question. "We see, by what precedes, that the principal idea of the author (Mr. Treussart) is, that there would be much more advantage in making, *directly*, mortar with fat lime, and trass, or factitious puzzalona, than in seeking first to make hydraulic lime, and afterward to compose mortars of this lime and common sand." This is very different from what Mr. Vicat

makes me say. It is now more than twenty-five years since I learned to appreciate the good effects of hydraulic limes, whether for constructions in the air or in water: I have employed them wherever I could procure them: during the nine years that I was at Strasburg, there were built, with hydraulic lime, in the works in water and in air, more than a million of masonry: I have, then, used this lime for a long time, and I think few Engineers have used more; it would be strange, therefore, in me to proscribe it. I was bound to show the precautions that should be taken in using it, so as not to risk making very bad mortar out of very good lime; I was bound to say what my experience had led me to think, namely, that, in places where good natural hydraulic lime could not be found, it is preferable, as regards the quality of the mortar, and as regards economy, to make hydraulic mortar, directly, by using fat lime and factitious trass, in lieu of attempting to make artificial hydraulic lime with which to compose mortars by the addition of common sand: the sequel of my experiments will leave no doubt in this respect. As to the reproach that Mr. Vicat brings, of my having used clays which were not suitable; I have to answer that we were obliged to use those afforded by the locality. I made various essays with argillaceous earths of the environs of Strasburg, and I could do no better. Mr. Vicat says, page 7 of his memoir, that his method consists "in kneading together lime and a certain quantity of gray or brown clay, or simply brick earth, facilitating the operation by the aid of a little water." He gives no other indication as to the nature of the clays that should be used. The experiments that I have given in Table No. IX, prove that it is not indifferent what kinds of clay are used, for the results are not, by a great deal, the same for all. We do not yet know the proportions that a clay should have, to afford the best results. I do not comprehend the reproach connected with having tried silecious sand pounded very fine. I know very well that we cannot compare our mechanical process with the processes of nature; but having seen that Mr. Descotils and Mr. Vitalis gave two different analyses of the Senonches lime, I wished to ascertain whether very fine silecious sand would give a hydraulic result: for if so, I should conclude, however feeble the result might have been, that limestones containing a mixture of silex only, might give good hydraulic limes. The objection that Mr. Vicat makes to me did not prevent his employing, in mixing clay with lime, a mechanical process of which the result cannot certainly be compared to mixtures existing in natural hydraulic limestones; still he was right in trying the mixture, since it succeeds with certain clays.

When I saw that the clays of the environs of Strasburg gave results very inferior to those which I obtained with mortar made of common lime and factitious puzzalona, I requested the *Chef de Battaillon*, Augoyat, of the Engineers, residing in Paris to send me a little of the hydraulic lime made at Paris by Mr. Saint Leger, according to the process of Mr. Vicat. He sent me some, directly as it came from the kiln; a part was in masses, the rest had been broken into small pieces and put into a bottle, which was then well sealed. I made, with the lime as soon as it arrived at Strasburg, experiments like those I had made with natural and artificial hydraulic lime. The following table contains the results of these new experiments.

TABLE No. X.

No. of the mortar.	Composition of mortars.		Made immediately.		At the end of 1 month.		At the end of 2 months.	
			H.	W.	H.	W.	H.	W.
			d's	lbs.	d's	lbs.	d's	lbs.
1	Paris hydraulic lime slaked to powder and measured in powder	1	12	187	15	88		
	Sand	2						
2	Same mortar		14	220				
3	Same mortar		16	246				
4	Same lime slaked in the air and measured in powder	1			20	55		
	Sand	2						
5	Same lime, measured in paste	1	15	253	25	99	30	88
	Sand	2						
6	Same lime	1	18	237				
	Sand	2¼						
7	Same lime	1	20	209				
	Sand	2½						
8	Same lime, measured the same	1	15	242				
	Sand	2						
9	Same lime	1	18	220				
	Sand	2¼						
10	Same lime	1	18	187	24	88		
	Sand	2½						
11	Lime of No. 5 slaked in air and measured in paste	1			30	88		
	Sand	2						
12	Lime of No. 5 slaked to powder and measured in paste	1					6	297
	Sand	1						
	Trass	1						

Observations on the experiments of Table No. X.

All the above mortars were made in the same way as the mortars of the preceding tables, that is to say, except for the mortars made of air-slaked lime; the lime was slaked to powder with one-fifth of its volume of water, whether made immediately or preserved for the periods indicated in the table. The mortars being made, they were put into boxes, and left in the air during twelve hours, like the others; after which they were put in water, and at the end of a year submitted to the proof of weights.

The first four numbers were made in the month of April 1823. No. 1 is proportioned with one part of lime slaked to powder, and two parts of sand: of this I made a mortar immediately after the slaking of the lime, and put it in water twelve hours afterwards: this mortar hardened in twelve days, and broke under a weight of 187 lbs. I left the rest of the lime in powder, in the air, and at the end of a month I made a mortar of it in the same way the first mortar was made. We see that the hardening required fifteen days, and that it would support only 88 lbs. No. 2 is a repetition of No. 1, being made of another piece of limestone: this piece appears to have been better than the first, since, of the two mortars made in the same way, the second result is sensibly the best.

The first two numbers were made of lime sent in masses without being

defended from the contact of the air. No. 3 was proportioned in the same way, but it was made of broken lime, sent in a well sealed bottle; this number gave a better result than the preceding, which I attribute to the lime being kept from contact of the air. Six or eight days may have elapsed from the time of taking the lime from the kiln, to the time of making the experiment. No. 4 was made of the piece of limestone of which No. 1 had been made; it was left to slake in the air, and at the end of a month I made a mortar with it, taking one part of this lime in powder and two parts of sand. We see that the hardening required 20 days, and that the mortar broke under the light weight of 55 pounds. The lime No. 1 which had been slaked to powder with water, gave a better result, after the same lapse of time.

The first four numbers were proportioned with one part of lime slaked to powder, and two parts of sand; a short time after having made these, however, I became convinced that hydraulic limes would not bear as much sand as had been commonly thought, as I have before stated. I, in consequence, requested Mr. Augoyat to send me some more artificial hydraulic lime from the same manufactory of Mr. Saint-Leger. This lime was sent to me like the first, partly in masses *(en pierre)* in a box, and partly broken up and put in bottles well corked and sealed. This was received in the month of May 1824, and it was with this lime that I made all the experiments of the above table, which follow No. 4, taking, for the proportion, one part of lime measured in paste, against the quantities of sand stated in the table. Mortar No. 5 being made with lime measured in paste, contains much less sand than mortar No. 1, in which the lime was measured in powder. Nos. 5, 6, and 7 were made of the lime contained in the bottles. The object of these three experiments was to ascertain the quantity of sand this lime would bear. We see that the mortar made of one part of lime in paste to two of sand, gave the best result. As I made no experiments with a less proportion of sand, I am not able to say whether this is the best proportion. I anticipated that the best result would be found to lie between two parts and two parts and a half, of sand, because I partook of the common error, that it was better to give too much, than too little sand. In making No. 5, I had slaked a certain quantity of lime to dry powder, by one-fifth of its volume of water, and I left a portion thereof exposed to the air, as I did with the natural hydraulic lime of the environs of Strasburg; at the end of one and two months, I made new mortars proportioned like those made immediately after slaking. We see that at the end of one month, this mortar had already lost nearly two-thirds of its resistance, and at the end of two months it had lost still more; we see, also, that the hardening was much slower.

Nos. 8, 9, and 10 are repetitions of Nos. 5, 6, and 7, with this difference only, that the former were made of lime sent to me in a box, while Nos. 5, 6 and 7 were made of lime sent in bottles. The best result with these is, again, that in which there is one of lime to two of sand. Of the mortars of these six experiments, if those be compared which have the same proportions, it will be seen that the mortars made of lime secured in bottles were always better than those made of lime which had not been perfectly shut from the air, notwithstanding that only about six days had elapsed from the taking the lime from the kiln to the making it into mortar. I have already remarked that No. 3, made of lime enclosed in a bottle, gave a better result than No. 2, of which the lime had been exposed to the air. We see therefore that this artificial hydraulic lime, loses part of its hydraulic properties,

promptly, by exposure to the air, as well as the natural hydraulic limes of *Alsace.*

No. 11 is an experiment made with the same lime as No. 5; but instead of slaking to powder with one-fifth of its volume of water, it was left to slake in the air for one month. At the end of this time it was reduced to powder, and I made it into paste by adding a little water, so that the proportions could be adjusted as in the other trials. The table shows that the hardening required 30 days, and that the mortar broke under a weight of 88 lbs., while mortar No. 5, composed of the same piece of lime, but made immediately, hardened in fifteen days, and sustained a weight of 253 lbs. before breaking. The comparison of No. 5 and No. 10 shows that lime which has been slaked to powder, has lost rather less of its quality at the end of a month, than that left to slake in the air during the same period. I will add, that when they sent me, in 1823, the lime of which the first three experiments were made, they also sent a little lime which had fallen spontaneously to powder. I left it in this state for two months; and I presume it had then been about three months exposed to the air: I made a mortar of this lime, taking one part of lime in powder to two parts of sand: the mortar which resulted was not able, after a years' immersion in water, to support the weight of the scale pan, which was 22 lbs.

No. 12, containing trass, was made with the same lime as No. 5, slaked to dry powder for two months. We see that No. 5, which was made of one part of this lime measured in paste, and two parts of sand, required thirty days to harden, and broke under the light weight of 88 lbs., while No. 12 hardened in the space of six days and supported 297 pounds before breaking. We see, therefore, that trass has the same influence on artificial hydraulic limes, as on natural hydraulic limes, and that it restores to them properties which they had lost by too long exposure to the air. I will here state that I was, last year, at the country seat of a Paris banker, who, having a spring of water, had caused a pond to be made in his garden. The spring being small, they had been obliged to cover the bottom of the pond with concrete, and to form the sides with a wall, all made of the artificial hydraulic lime of Mr. Saint Leger. The basin had been finished about a year, but a great deal of the water filtered through it: I examined the mortar and found it had a very feeble consistence: I questioned the architect as to the manner he had treated the lime, and he told me that he had caused a considerable quantity to be brought at once, and deposited in a spot sheltered from the rain, that sometimes he used it immediately, as it arrived, and sometimes, after it had fallen to powder. This explanation showed me that the evil proceeded from having used the lime that had been too long from the kiln, and which had already lost a great part of its hydraulic property.

Mr. Vicat appears not to have observed the bad results obtained with hydraulic limes which have been exposed some time in the air, whether slaked to powder with water, or slaked spontaneously: he even appears to incline to the process of air-slaking, for, after having given the three modes of slaking, he says, page 20: "such are the modes of slaking: the first is generally used; the second has hardly been employed except by way of experiment at certain works; the third is proscribed, and represented in all treatises on construction, as depriving the lime of all energy, to such a degree that all lime fallen to powder by air-slaking is considered as lost. We do not now allude to the processes of Rondelet, Fleuret, and others, because they do not differ enough from those described to be separated from them.

We shall see, further on, relative to spontaneous slaking, how necessary it is to be mistrustful of condemnatory assertions, springing out of false observations, and accredited by authors who know how to doubt of nothing, and who repeat, without examination, the errors of others."

At page 25, Mr. Vicat says, again, "the three modes of slaking arranged in the order of superiority, relative to the resistance, and the hardness they communicate to the hydrates of common fat lime, are: 1st. Ordinary slaking; 2nd. spontaneous slaking; 3d. slaking by immersion. The mean relative resistances, in the three cases, are the numbers 2490, 1707, 450, and the hardness as $0.^{d}1696$, $0.^{d}0850$, $0.^{d}0713$.

"The order changes for hydraulic lime, and becomes: 1st, ordinary slaking; 2d, slaking by immersion; 3d, spontaneous slakings. The mean relative resistances are as the numbers 864, 392, 245, and the hardness as $0.^{d}0488$, $0.^{d}0446$ $0.^{d}0358$."

The above experiments of Mr. Vicat were made with hydrate of lime, that it to say, with limes reduced to paste with water. We see that ordinary slaking gave better results than spontaneous slaking; with both fat lime and hydraulic lime. In his table No. XVIII., which contains eight mortars made with diverse hydraulic limes, and sand; the first five gave greater resistances when the lime was slaked in the ordinary way than when slaked spontaneously. The mortars made of fat lime and sand, as exhibited in tables Nos. XIX., XX., and XXI., gave, it is true, better results when these limes were slaked spontaneously: but with hydraulic limes he, himself, obtained results very different, since the mortar No. 5 of table No. XVIII. gave a resistance represented by 4102 when the lime had been slaked by the ordinary process, while it was only 3082, when the lime had slaked spontaneously. The experiments of Mr. Vicat are, therefore, far from causing us to reject the old saying of masons as to the bad results obtained from air-slaked lime; and we do not perceive how he could regard this saying as a condemnatory assertion growing out of false observations. This old saying appears to me to be well founded as to the greater number of hydraulic limes. Mr. Vicat, in giving his experiments, had not said for how long a time he left the limes which he slaked by the second and third processes, in the air. If he had made comparative experiments, he would have had very variable results, according as the hydraulic limes used had been, for a greater or less time, exposed to the influence of the air.

All that precedes proves that hydraulic limes, whether natural or artificial, lose much of their hydraulic property if not used soon after they are calcined. As an exception, a single piece of lime, of which the experiments in table No. VI. were made, gave to the mortar, after fifteen days slaking, a better result than to the mortar made immediately; but we see that the resistances of the mortars made at periods more remote from the slaking, diminished rapidly: we may therefore say, in relation to all the hydraulic limes that I have treated, that it is necessary to make the mortars soon after they come from the kiln; for I assured myself that the same deterioration took place with the limes of Bouxviller, Oberbronn, Verdt, &c., although I did not make as detailed experiments with them as with the Obernai lime. All, in fine, induces me to believe that the greater part of hydraulic limes are thus affected. It is consequently very important, before using them, to see if they do not soon lose, by exposure to the air, a great part of their hydraulic quality.*

* We see, by the above, how many precautions should be taken with hydraulic lime. Parker's cement which has been burned and pulverized, is brought from England: this

The artificial hydraulic lime, made by Mr. Saint-Leger at Meudon, to supply the wants of the Capital, is made of chalk which is mixed with $\frac{2}{10}$ of clay brought from Vanvres, near Paris. This clay contains the following substances: silex, 0.630; alumine, 0.282; oxide of iron, 0.068. A cubic metre of this lime (35.34 cubic feet) costs at Paris about $13,50. If it be examined minutely, there will be seen small portions of clay that have not been well mixed. This is an inevitable result, because we cannot, by a mechanical operation, obtain a mixture as intimate as that existing in natural hydraulic limes. The results which I obtained with this lime are a little superior to those that I got from the Holsheim clay, of which the resistances varied from 187 to 215, while with the hydraulic lime of Paris, I obtained from 187 to 253. This might be owing to their having sent me choice pieces of lime. I made, besides, too few experiments with the Holsheim clay to be able to affirm that it is really inferior to that of the environs of Paris for making artificial hydraulic lime.

Captain Petitot of the Engineers sent me from *Vitry-le-Francais* a little hydraulic lime of the environs of that place of which he had made trial, obtaining, as he informed me, good results. This lime comes from chalk; it is very white; water being sprinkled on it, as it comes from the kiln, about five minutes elapses before slaking begins. One part of quick lime gave 1.30 of paste. I do not know the degree of resistance that mortars made of this lime would give; but I made the following experiment with it: I took a portion which was sent to me in a well stopped vessel, as soon as it was withdrawn from the kiln; I made a paste of this with water; I left it in the air for one hour, and then plunged it in water: it took a good consistence in a very short time, and at the end of four days it was very hard. This lime, therefore, hardens more promptly than any of the hydraulic limes of Alsace and Metz, and than any of the artificial hydraulic limes that I have examined. The only exception is the Obernai lime, shown in table No. VI. The Boulogne pebble lime hardened sooner; but it is remarkable that the mortars of this lime which hardened soonest, presented a weak resistance; while those which were slower to indurate, gave a greater. The Vitry lime appeared to me to harden in the manner of good hydraulic lime, and to promise to furnish very good mortars. This lime costs in the neighborhood, only $3.50 per cubic metre (35.34 cub. feet,) while we see, above, that the Meudon lime costs about $13.50. It would therefore, be a good speculation to bring the hydraulic lime necessary for the Capital, from Vitry. The river Maine, which is navigable as far as Vitry, would give great facility to the transportation. As wood is scarce in the neighborhood of Vitry, as coal is not easy to be obtained, and as it is advantageous to use hydraulic limes soon after calcination, it would perhaps be best to bring the chalk, of which the lime is made, to Paris; and to burn it with coal, as it might be wanted—profiting of favourable seasons for collecting a stock of the chalk.

The experiments which I made with the Boulogne pebbles, induced me to think that the soda it contained, might have some agency. I made, therefore, various experiments, by reburning fat lime with a little clay, and adding some water containing soda or potash. I proceed to give the results.

lime may be good in England, and have lost a great part of its properties on arriving in France. It is necessary, therefore, to try, before using it.—*Author.*

Table No. XI.

No. of the mortar.	Composition of the mortars.		LIME			
			Burned as commonly.		Burned more highly	
			H	W	H	W
			days	lbs	days	lbs
1	Fatlime, reburnt with 2-10 of pipe clay, and measured in paste Sand	1 2 } 3	8	132	15	187
2	Same lime, reburnt with 3-10 of pipe clay, 1-10 of solution of soda at 5°, and measured in paste Sand	1 2 } 3	18	176	20	209
3	Same lime reburnt with 2-10 of pipe clay, and 1-5 of solution of soda at 5°, and measured in paste Sand	1 2 } 3	8	220	15	242
4	Same lime, reburnt with 2-10 of pipe clay, and 1-4 of solution of soda at 5°, and measured in paste Sand	1 2 } 3	8	176	18	231
5	Same lime, reburnt with 2-10 of pipe clay, and 1-3 of solution of soda at 5°, and measured in paste Sand	1 2 } 3	9	154	18	220
6	Same lime reburnt with 2-10 of pipe clay, and 1-2 of solution of soda at 5°, and measured in paste Sand	1 2 } 3	10	121	18	198

Observations on the Experiments of Table No. XI.

To make the above experiments I took fat lime which I reduced to paste, with water: I then mixed it well, with $\frac{1}{10}$ of the Cologne pipe clay, of which the analysis has been given: this is lime No. 1. For No. 2, I added $\frac{1}{10}$ of the solution of soda of the strength of 5° of the *pèse acid*. The volume of solution of soda was taken in relation to that of the lime in paste, and with it I diluted the pipe clay before mixing it with the lime. In the succeeding numbers, I successively tempered the pipe clay with $\frac{1}{5}$, $\frac{1}{4}$, $\frac{1}{3}$ and $\frac{1}{2}$ of the solution of soda of the same strength. Each of these experiments was made in duplicate; one half of each mixture was placed in such a situation in the lime kiln, that it would receive only the mean degree of heat: the other half was exposed to a higher temperature. I satisfied myself of the degree of heat sustained, by placing unburnt bricks by the side of the crucible containing the mixtures. From the colour of these bricks I knew that the second set had been more highly calcined than the first. Immediately after the calcination, I made mortars with one part of lime in paste and two of sand. The mortars are given in the table in two series according to the two degrees of calcination. It will be noticed, at once, that the more highly calcined lime, gave the greater resistance, but the slower rate of hardening. No 1, containing pipe clay only, gave a resistance of but 132 lbs. for the lime the least burned, and 187 lbs. for that most burned, No. 2, which contained $\frac{1}{10}$ of solution of soda, gave a slight augmentation of resistance, and No. 3, which contained one-fifth of solution of soda, gave

a greater resistance for both degrees of calcination. Beyond the proportion of one-fifth solution of soda, the weight supported went on decreasing; but up to the proportion of one-fifth the resistance was increased, by the addition of a little soda, about in ratio of 6 to 7. These experiments were made in the month of January.

Having made the above experiments with clay and soda, I made similar ones with potash: the results obtained are in the following table.

Table No. XII.

No. of the mortar.	Composition of the mortar.	No. of days required to harden in water.	Weight supported before breaking.
		days	lbs
1	Fat lime, reburnt with 2-10 of pipe clay and 1-10 of solution of Potash at 5°, measured in paste . . . 1 Common sand . . . 2 } 3	6	242
2	Same lime, reburnt with 2-10 of pipe clay and 1-5 of solution of Potash at 5°, measured in paste . . . 1 Sand . . . 2 } 3	8	297
3	Same lime reburnt with 2-10 of pipe clay and 1-4 of solution of Potash at 5°, measured in paste . . . 1 Sand . . . 2 } 3	12	242*
4	Same lime reburnt with 2-10 of pipe clay and 1-3 of solution of Potash at 5°, measured in paste . . . 1 Sand . . . 2 } 3	15	407
5	Same lime, reburnt with 2-10 of pipe clay and 1-2 of solution of Potash at 5°, measured in paste . . . 1 Sand . . . 2 } 3	18	275

Observations on the experiments of Table No. XII.

The experiments in the above table were made in the same way, and at the same time, as the experiments of table No. XI. These limes were burned by the side of those of table No. XI, which gave the best results. No. 1 of table No. XI, containing pipe clay alone, serving equally as a term of comparison for the above table. We see, in table No. XI, that the greatest resistance obtained by the mixture of lime and pipe clay only, was 187 lbs. The experiments of tables Nos. XI and XII differ only in substituting in the latter, potash for soda. We see that the results obtained with potash are superior to those obtained with soda. No. 3 of the above table being cracked, I am uncertain whether the greatest resistance belonged to No. 3 or No. 4. No. 5 shows that the proportion of one-half potash, diminished the resistance. I made a sixth experiment by putting one-half of potash at 10°: the mortar resulting broke under a load of 242 lbs. It is remarkable that the mortars which gave the greatest resistance were those which hardened the most slowly. Several of the preceding tables gave the same result; it was quite striking with the Boulogne pebbles of table No. VIII. It will there be seen that No. 1 which hardened in twelve hours, supported a weight of only 108 lbs., while No. 12, which supported 286 lbs.,

* This mortar was cracked on being cut, which diminished its strength. Ac.

required 12 days to harden. An inspection of the preceding tables will show that, in general, the mortars which gave good results, took from 8 to 15 days to indurate, whether made of natural or artificial hydraulic lime. The experiments of table No. XII were made in the month of January. I also made essays with the soda and potash of commerce, which, as is known, are composed of sub-carbonates, sulphates and muriates of these substances: the results obtained were not so good.

I made several experiments with lime and solutions of potash and soda without other admixture. I operated in this way: I took several pieces of fat lime as they came from the kiln, and slaked them to dry powders thus,—on the first piece I sprinkled the fourth of its volume of solution of soda standing at 5° of the *pèse-acid*; on the second, the same quantity of solution of the sub-carbonate of soda of commerce, of the same strength; on the third, the same quantity of an equally strong solution of potash: on the fourth a like quantity of solution of the same strength of the sub-carbonate of potash of commerce; and on the fifth an equal quantity of solution of muriate of soda, also standing at 5°. I left these several powders in the air for one month; I then added the quantity of water requisite to produce a paste, and had them reburnt in a lime kiln. As they were drawn from the kiln I slaked them with a little water, and left them in the air, for some days: I afterwards made mortars of them, by mixing them with sand, and having allowed them to harden in the air for twelve hours, I placed them in water: the two first mortars hardened in two days; the third, the fourth and the fifth hardened in a day and a half. At the end of a year, I wished to break these mortars: and I was much surprised to find that, notwithstanding they had hardened so promptly, they had become entirely soft. As the boxes containing these mortars were covered with others, I had not been able to observe them at the period to their beginning to lose hardness.

It follows from experiments made up to this time, that it is clay,—that is to say, a mixture of alumine and silex, united with the lime, that gives good hydraulic lime by calcination. (An exception exists in the lime of Senonches, which is said to be very hydraulic, and which appears to owe this property to silex alone.) We do not as yet know the proportions in which silex and alumine ought to exist, to give the best results. Hydraulic limes are improved by adding to the mixture of clay and lime, a little soda: the result is still better if potash be used instead of soda. We have seen that the Boulogne pebbles gave a lime which hardened very quickly, but which would not bear mixture with any other substance, in making mortar—this being the only lime which gave this result. I before observed that it appeared to me these pebbles contained a little soda: but we have just seen that limes which I caused to be reburned with a little soda or potash gave good mortars when mixed with a considerable quantity of sand: it seems, therefore, as I have remarked, that these pebbles contain some substance which escaped analysis, or else that some of the substances known to be present are modified by the sea-water.

In comparing artificial hydraulic limes, I have been led to remark that better results were obtained when, in lieu of making the mixture of clay, with lime just from the kiln, I first slaked the lime with one fifth of its bulk of water, and left it, in this state, in the air for a month or two. I do not attribute the better effect solely to a more minute division of the lime: but I think that the slaked lime exposed to the air, absorbing much oxygen, as I have shown in page 318, is capable, in this state of oxidation, of com-

bining better with the clay which is mixed with it. I proposed making experiments to ascertain what might be the advantages of this process, and also during what time it would be proper to have exposed to the air, lime that had been slaked to powder, or lime designed to be left to spontaneous slaking; but I was obliged to quit Strasburg, before having it in my power to make these experiments.

ART. V.—*On Hydraulic Mortars made of fat lime and trass, or fat lime puzzalona.*

Trass is a substance obtained from the village of Brohl, near Andernach, on the Rhine; this village is situated at the foot of an extinct volcano. Trass is of a grayish colour, much resembling gray clay which has been calcined. I have seen several pieces of trass which were covered with lava. This last substance differs much from trass: the separation is distinct: the lava which covers the trass is of a blackish colour, and its surface is full of asperities and cavities, showing that it has sustained a very high heat, and very rapid cooling: trass seems to have been exposed to a much lower heat.

Puzzalona is likewise a burned clay—deriving its name from the village of Puzzoles, at the foot of Vesuvius; it is found at or near the surface. According to Mr. Sganzin, there are a great many varieties of puzzalona: it is found white, black, yellow, gray, brown, red, and violet.

It is not known whether trass and puzzalona result from banks of clay which have been highly heated by incumbent lava, or whether they have been thrown out of volcanos during irruptions; it is possible that both suppositions may be true; an examination on the spot can alone remove uncertainty in this respect.

Puzzalona is, according to Mr. Sganzin, also obtained near Rome: this is of a red-brown, and contains brilliant particles having a metallic lustre.

The Dutch have a great trade in Trass. They get out this substance in masses, and reduce it to a very fine powder, by means of wind mills. Much has been sent to France, to the North, and to England; but it seems that the commerce has diminished a little. Some authors call this substance the Terras of Holland.

Arches, in several of the gothic churches, in Belgium were built of pieces of the Andernach Trass: as was the case in several edifices on the Rhine. The great lock of Slikens in Belgium, was rebuilt with pieces of the arch of a demolished church; and by pulverizing the same material, a very good trass was obtained.

On the shores of the Mediterranean, much puzzalona, furnished from the environs of Rome and Naples, is used. The good effects of this substance were known to the Romans, for Vitruvius, Book II., Chapter VI., has the following passage. "There is a kind of powder to which nature has given an admirable quality: it is found near Baie, and in the grounds around Mount Vesuvius. This powder mixed with lime and stones, not only renders common masonry very firm, but it even unites and hardens in a remarkable manner, masonry at the bottom of the sea."

I had occasion to appreciate the good effects of trass in the great works of Vesel. It was brought in powder, and as it was transported in batteaux descending the Rhine, it was not dear. Before becoming acquainted with the excellent qualities of the Obernai hydraulic lime, I caused some of it to be brought to Strasburg, and the first hydraulic works that I constructed

at Strasburg were made of mortar composed of fat lime, sand, and trass. But the trass cost much more at Strasburg than at Vesel, on account of the export duties that the Prussians levied on it, and because of the difficulty of ascending the Rhine. A cubic metre (35.34 cub. feet) cost 120 francs (about $23.00) at Strasburg, which raised the cost of the hydraulic mortar enormously. I had begun some researches with a view to make artificial trass, when I became aware of the hydraulic properties of the Obernai lime. This lime was afterwards used without trass in the foundations of revetments, in the construction of bridges, and in all masonry exposed to the air; but in the foundation of locks and dams and in the construction of caps for under-ground casemates, a little trass was always mixed in the mortar, with the lime and sand. I continued my experiments on the forming of artificial trass, less for our particular advantage at Strasburg, therefore, than for those places which do not afford good natural hydraulic limes. I succeeded, in the end, as will be seen in the following Article, in making artificial trass equal in quality to natural trass or puzzalona. The cost of a cubic metre (35.34 cub. feet) was about 30 francs (about $6.00.) I caused the puzzalona to be brought from Naples, it was red, and much resembled brick or tile dust.

An analysis of trass and puzzalona, made many years ago, may be found in the *Précis du cours de construction* of Mr. Sganzin of the Polytechnic school. Mr. Berthier asked me for samples of the trass and puzzalona which I used at Strasburg, and made an analysis of them. Both analyses are given below.

	Old analysis.		Mr. Berthier's analysis.	
	Trass.	Puzzalona	Trass.	Puzzalona
Silex -	0.570	0.350	0.570	0.445
Alumine -	0.230	0.400	0.160	0.150
Lime -	0.065	0.050	0.026	0.088
Magnesia -			0.010	0.047
Oxide of iron*	0.085	0.200	0.050	0.120
Potash -			0.070	0.014
Soda - -			0.010	0.040
Water -			0.096	0.092
	0.950	1.000	0.992	0.996

We see that the new analysis of trass and puzzalona by Mr. Berthier differs in several points from the preceding analysis. According to that of Mr. Berthier, trass and puzzalona contain potash and soda which were not before noticed in those substances. According to the old analysis, puzzalona contains much more alumine than trass, but according to Mr. Berthier, about the same. The proportion of alumine to silex is greater, for both substances, in the old, than in the new analysis. I will add that Mr. Berthier discovered that the trass and puzzalona which I sent him attracted the magnetic needle.

We ought not to be surprised that these analyses differ sensibly, because it has been known for a long time that different puzzalonas give very dif-

* In Mr. Berthier's analysis, there was in the Puzzalona, oxide of iron and titanium 0.120.—Author.

ferent results, and it is the same with trass. We can conceive that these substances may vary considerably, because the several strata of clay in the same bank often vary sensibly. I proceed to give different experiments made with fat lime, puzzalona, and trass.

Table No. XIII.

No. of the mortars	Composition of the mortars.			No. of days which they took to harden in wat'r	Weight which they supported before breaking.
				days.	pounds.
1	Fat lime of Strasburg slaked to powder and measured in powder	1	3	5	411
	Sand	1			
	Trass	1			
2	Lime the same, do.	1	3	4	330
	Trass	2			
3	Lime the same, do.	1	3	4	499
	Sand	1			
	Puzzalona	1			
4	Lime the same	1	3	3	444
	Puzzalona	2			
5	Fat lime from Vasselone, do.	1	3	5	449
	Sand	1			
	Trass	1			
6	Lime the same, do	1	3	4	385
	Trass	2			
7	Fat lime from Brunstat, do.	1	3	5	510
	Sand	1			
	Trass	1			
8	Lime the same, do.	1	3	4	535
	Trass	2			
9	Lime from white marble, do.	1	3	5	308
	Sand	1			
	Trass	1			
10	Lime the same, do.	1	3	4	407
	Trass	2			
11	Same lime, do.	1	3	4	396
	Sand	1			
	Puzzalona	1			
12	Lime the same, do.	1	3	3	367
	Puzzalona	2			
13	Strasburg fat lime measured in paste	1	3	4	495
	Puzzalona	2			
14	Lime the same	1	3½	5	550
	Puzzalona	2½			
15	Same lime slaked to powder and measured in powder	1	3	3 to 16	231 to 580
	Trass	2			

Observations on the experiments of Table No. XIII.

The lime of the first twelve numbers was measured in powder and mixed with the substances indicated in the table. It will be seen that I used various fat limes of the environs of Strasburg. I satisfied myself that these limes had no hydraulic property. The first four numbers were designed to ascertain whether puzzalona is preferable to trass. The puzzalona gave me rather the best results—the lime being the same in all. The experiments 9, 10, 11, and 12 confirm the first four. We see that I had a greater resistance by mixing sand with the lime and puzzalona, or lime and trass,

than when there was no sand. The limes of Nos. 13 and 14 were measured in paste, and we see that I obtained a better result by augmenting the proportion of puzzalona.

No. 15 contains the results of many trials made with 1 part of fat lime measured in powder and 2 parts of trass. The time of hardening varied from 3 to 16 days, and the resistance from 231 to 580 lbs. But I had few mortars giving a result so feeble as 231 lbs., or so strong as 580 lbs. We might say that the mean resistance with mortars composed of fat lime, sand and trass, was between 352 and 374 pounds. The mortar which gave 580 pounds contained lime and trass only. If, with the same substances, I had composed a mortar of lime, sand, and trass, I should have had, probably, a still better result. I found fewer variations with puzzalona than with trass, probably because, having but a small quantity of the former, my experiments were few. We shall, however, see in table No. XX., that a mortar like No. 13 of the above table, broke under a weight of 286 lbs. I am uncertain whether this weak result was due to particular circumstances or to the quality of the puzzalona. It appears to me, in general, that there was no great difference between the trass and the puzzalona, that I used.

In comparing the results of table XIII., with those of the preceding tables in which mortars were made of natural or artificial hydraulic lime and sand only, we see that these last hardened much more slowly, and gave much less resistance, than mortars made of fat lime, sand, and trass or puzzalona. Mr. Gauthey was therefore in error, as I noticed page 235, when he stated that mortars made of fat lime and puzzalona did not take consistence in water and remained pulverulent.

In the observations made by Mr. Vicat on the pamphlet which I published in 1824, and of which I have already spoken, this Engineer remarks as follows: "The greatest resistance that Mr. Treussart found for trass mortars immersed for one year, is 17 $\frac{6}{10}$ lbs. for four-tenths of an inch square, and I have made mortars with lime and sand, which, after a year's exposure on a roof to all the inclemencies of the seasons gave a resistance of 31 lbs. and even of 40 lbs." The results that Mr. Vicat and I obtained are very different. These differences can only be attributed to our having used means of measuring the resistance, or rather the tenacity, of mortars, which do not admit of comparison. I will observe, however, that the greatest resistance I found was 579 lbs., for mortar made of artificial trass, and that the section being four square inches, there results 23.1 lbs. for four-tenths of an inch square instead of 17 $\frac{6}{10}$ lbs., as Mr. Vicat supposes. He does not say what were the dimensions of the mortars he submitted to proof in order to compare his results with mine; and as a year had not elapsed from the publication of my pamphlet to the appearance of his observations, I conclude that he did not use the same method in breaking the mortars of which he speaks and which he says had been made a year, that I did. Of twenty-five tables that Mr. Vicat's memoir contains, the weights supported by mortars, are given only in three instances—to be found in table No. III. All the other results of the tables are resistances obtained by calculation from the penetration of a rod subjected to an impulsive force, and deduced from the few experiments of table No. III. This table indicates that the mortars had 1 inch 6-10 of base, by 1 inch in height, and that the weights were applied at the extremity of a lever of only 1. $\frac{2}{10}$ long. But the mortars which I submitted to fracture, were two inches square, they rested on two points of support, distant four inches from each other; the weights were applied to the middle of the mortar: thus the dimensions of the mortars and

the arms of the levers to which the weights were applied, were entirely different, in the two methods. We, cannot therefore, compare the weights supported by four-tenth of an inch square, when the methods were so different. I will add to what I said page 305, that if Nos. 26 and 33 of my table No. III. be submitted to the proof of the rod of Mr. Vicat, it is possible that the rod would penetrate less into No. 33, which contains three parts of sand, than into No. 26 which contains none. Whence we might assign to No. 33 a higher resistance than to No. 26, whereas its actual resistance is three times less. If sand (alone) be compressed in a metallic tube, and then submitted to the rod of Mr. Vicat, which is terminated by a flat portion, it will penetrate but little into the sand; and the false consequence would appear that the sand possessed tenacity. It is to be noticed that when the lime takes consistence, it fulfils, as regards the resistance of the sand to the shock of the rod, the function of an enclosing vessel. The means used by Mr. Vicat to determine the tenacity of mortars, appears therefore to be bad, and his results not of a nature to be brought into comparison with mine.

The experiments stated in the above table, and especially those comprised under No. 15, suggested anew to me an idea that I had already entertained regarding hydraulic limes: namely, that the differences in the results might not be attributable solely to diversity in the trass, but might result from using the lime sometimes immediately from the kiln, and sometimes after having been left for a period exposed to the air after having been slaked to powder. I consequently made experiments to know the influence exercised by the air on fat lime—these are stated in the following table.

Table No. XIV.

No. of series	Composition of the mortars.	Made immediately.	After 5 days.	After 10 days.	After 20 days.	After 1 month.	After 2 months.	After 3 months.	After 4 months.	After 5 months.	After 6 months.	After 7 months.
		lbs	lbs	lbs	lbs	ls	lbs	lbs	lbs	lbs	lbs	lbs
1	Fat lime slaked to powder and measured in powder 1, Sand 1, Trass 1 — 3	242 days (20)	231 d (18)	253 d (16)	275 d (12)	319 d (5)	396 d (4)	363 d (5)	374 d (6)	386 d (8)	407 d (10)	396 d (12)
2	Lime the same 1, Trass 2 — 3	374 (16)	341 (11)	341 (8)	407 (6)	440 (4)	440 (3)	462 (3)	418 (4)	429 (6)	506 (8)	462 (10)
3	Fat lime air-slaked and measured in powder 1, Sand 1, Trass 1 — 3					253 (9)	308 (6)	286 (6)	308 (7)	319 (9)	352 (12)	330 (12)
4	Lime the same 1, Trass 2 — 3					319 (7)	363 (4)	385 (4)	352 (5)	341 (5)	385 (7)	352 (8)

Observations on the Experiments of Table No. XIV.

For making the above experiments I took fat lime as it came from the kiln, and slaked a part to dry powder with a quarter of its volume of water.

I then made two mortars, taking for the first, one part of this lime in powder, one of sand, and one part of trass, and for the second mortar the same quantity of lime and two parts of trass. These two mortars are in the first column, and will serve as terms of comparison for the rest. I then put in a vessel the remainder of the lime slaked to powder, and made mortars of it, of the series No. 1 and 2, at the periods indicated in the table. When I slaked this lime to powder I left another portion to slake in the air, and at the end of a month I commenced the series of experiments therewith, marked Nos. 3 and 4. I took care to use the same trass in all the mortars. I must remark that the figures in brackets express the number of days the mortars required to harden, and the figures over those in brackets, express the weights supported before breaking.

The series comprised under No. 1 was made of one part of lime in powder, to one part sand and one part trass. We see that the hardening of the mortars which were made soon after the slaking, was slow; at the end of a month it was much more prompt, and after three months, it again became slower. The numbers representing resistances present prominent anomalies; but we must look at the whole rather than at the particulars. The *whole* of this series shows that mortars made of lime slaked to powder, and exposed to the air for a month and more, gave better results than those made immediately, or soon after the slaking of the lime,

These experiments were commenced in the middle of April, 1823; the numbers, therefore, which express the most prompt hardening, correspond to the hottest months, and according to the observation of Mr. Vicat, mortars harden in the water more promptly in summer than in winter. The two last columns correspond to the months of October and November, and although the hardening had then, again, become slower, the resistance had not lessened. The experiments of table No. XIII. were made with lime which had remained slaked in powder about one month. The first twelve numbers were made in September and October and No. 13 and 14, in the month of January: I, however, got a prompt hardening. It appears that by exposing fat lime which has been slaked to powder, to the air for some time, the induration is favoured: but there is no doubt that heat contributes much thereto.

The series of experiments comprised under No. 2, were made of one part of lime in powder to two parts of trass. We see, here also, that the resistances that I obtained a short time after the slaking are inferior to those got one month after the slaking. The experiments of table No. XIII. often gave me with sand and trass, better results than with trass alone, while it is the contrary in the above table. I attribute this anomaly to the difference in the trass used.

The series comprised under No. 3 and 4, were made in the same manner as the two first series, with this difference that air-slaked lime was used. It was not before the expiration of a month that I had enough of this lime to commence the experiments. If we compare the third series with the first, and the fourth with the second, we shall see that the results are in general inferior with the air-slaked lime. I will add that all the mortars made of lime slaked to powder were very homogeneous, while those of air-slaked lime exhibited, in the interior, a multitude of white points which appeared to me to be particles of lime that had absorbed carbonic acid; they were very apparent when the mortars were broken. I think, therefore, that it is better to slake fat lime to a powder, than to air-slake it.

I ought to observe that before making the experiments oft able No. XIV.

I had made several of the same kind but less complete; and that I had often got contradictory results, that is to say, sometimes, I obtained a greater resistance when I had made mortar of lime just as it came from the kiln, than when I slaked it to powder and left it for some time in the air. Sometimes, also, I got better results with air-slaked lime than with that slaked to powder; the differences were not great but they existed. On examining my notes, I saw that in making my first experiments, I changed the trass several times; this induced me to keep back these previous results, and the anomalies that I found therein determined me to make the experiments of the above table, in all of which the same trass was used.

These experiments should, no doubt, be repeated with several kinds of lime, to ascertain whether it will always be better to use fat lime as soon as it is burned, or sometime after having slaked it to dry powder. It is necessary to repeat the experiments both in summer and in winter. As to air-slaked lime, it appears to me that this process ought not to be adopted, because of the great quantity of white particles which I found in all the mortars of this kind that I made.

This manner of slaking fat lime is that which Mr. Vicat prefers: he, in *Annales de chimie*, Vol. XIX. page 22, publishing as follows: "The assertion of Mr. John relative to lime exposed to the air is in contradiction to recent facts, so presented, and so multiplied, that I am constrained to combat it. It was I who first announced that fat lime slaked spontaneously, and abandoned for one year to the action of the air, under cover and protected from winds, gives better results, than when employed immediately, according to the common method. This conclusion is founded on a hundred and fifty experiments, varied in several ways: it results, for example, that the force of ordinary mortar being, in the most favourable case of a series of experiments represented by 1506, that of mortar made of air-slaked lime gave, under the same circumstances 2293." Mr. Vicat acknowledges that the ideas, commonly received, on this point of the doctrine of mortars, are all in favour of Mr. John, and he says, because of this sentiment, almost general, he presumes Mr. John did not examine the matter. I will remark, touching this point, that Lieut. Col. Bergere of the Engineers, notices, in the last *devis instructive*, and in the account he has given of the work of Mr. Raucour, that several Engineers have thought, in times long gone by, that air-slaking gave better results than the other two processes, and that this mode has been in use, from time immemorial, in Spain, and in a part of Italy. Mr. Bergere says that he used it at Flushing; and that this method is recommended in a letter written in 1764 by Mr. Sienne, an Engineer officer, resident at Graveline. I do not however counsel the process of air-slaking in making hydraulic mortar with fat lime and trass, or other analogous substance; because the mortars made in this way contain a great many white specks which appear to be lime passed to the state of carbonate. We may conceive, in fact, that when lime is left to slake spontaneously, every successive small portion of lime remains for some time exposed to the contact of the air, as the lime falls off in successive layers: there ought, therefore, to be a considerable absorption of carbonic acid: whereas lime slaked to powder with water and formed into heaps, has the surface only exposed to the air.

Besides the experiments of the above table, I have made others of the same kind, by slaking fat lime into thick paste, and into thin paste—comparing these results with each other, and with those I got from the same lime slaked to powder.

These experiments are in the following table.

Table No. XV.

No. of series	Composition of the mortars.	Made immediately.	After 5 days	After 15 days.	After 1 month.	After 2 months.	After 3 months.	After 4 months.	After 5 months.	After 6 months.	After 7 months.	After 8 months.	After 9 months.	After 10 months.	After 11 months.	After 12 months.
1	Fat lime slaked to thick paste 1	lbs 319	lbs 341	lbs 352	lbs 374	lbs 341	lbs 363	lbs 341	lbs 385	lbs 352	lbs 341	lbs 319	lbs 341	lbs 330	lbs 341	lbs 363
	Sand 1 4/5 3/4	(12)	(12)	(14)	(16)	(18)	(20)	(18)	(16)	(10)	(5)	(5)	(6)	(8)	(10)	(13)
	Trass 1 4/5 3/4															
2	Fat lime slaked to thin paste 1								308	297	308	275	286	253	275	
	Sand 1 4/5 3/4								(10)	(5)	(6)	(6)	(8)	(10)	(13)	
	Trass 1 4/5 3/4															
3	Fat lime slaked to powder and measured in paste . . . 1								356	352	341	352	363	341	352	
	Sand 1 4/5 3/4								(8)	(5)	(5)	(6)	(8)	(10)	(13)	
	Trass 1 4/5 3/4															

Observations on the experiments of Table No. XV.

To make the experiments of the above table, I took fat lime as it came from the kiln, and divided it into three portions: one of these portions was

slaked to a thick paste and left in a vessel; another portion was slaked to a thin paste, and, as it thickened, I added a little water so as to keep it in the consistence of sirup; the third portion was slaked to a dry powder with one-fourth of its bulk of water, and put, like the others, in an open vessel. I, immediately, made the mortar in the first column, which may serve as a term of comparison. The others were made, at the periods expressed in the table, of lime slaked in the several modes mentioned. In proportioning the parts, I added, when I made the mortar, a little water to the lime which had been slaked to a thick paste and also to that which had been slaked to powder, so as to bring all to the condition of that slaked to thin paste. These experiments were begun in the month of November, 1823, that is to say seven months after the experiments of table No. XIV. In table No. XV, I have followed the same mode of expressing the time required to harden, as in table No. XIV. The mortars of three series were made of the same quantities of lime, sand and trass; and I took care, as in the preceding table, to use the same trass, and the same sand, for all.

In the first series of the table, the mortar made immediately gave a result rather weaker than those made afterwards: the hardening was more prompt in summer than in winter.

I left the lime of the second series for six months in a state of clear paste before using it. We see that the results were not so good as those obtained from the thick paste. There are, certainly, several anomalies in the results, but, as before remarked, we must look at the *whole*.

The third series was likewise commenced at the end of six months. In table No. XIV, the mortars of the first series, made of lime slaked to powder, were formed at appropriate periods, which were not extended beyond seven months. The resistances obtained in table No. XIV are not the same as those obtained in Table No. XV, because the proportions were different: but if we compare the experiments of the first series of table No. XIV with those of the first and third series of table No. XV, we shall see that instead of making hydraulic mortar of fat lime, sand and trass, immediately after slaking the lime, it will be more advantageous, after slaking the lime, with a little water, as it comes from the kiln, to leave it exposed to the air for some time. We see, here again, that the hardening was more slow in winter than in summer. If we compare the results obtained in the preceding tables, we shall see that there is a great difference in the effects of mortars made of natural or artificial hydraulic lime and sand, and of those made of fat lime, sand and trass. When the first are made of lime which has for some time slaked to powder, or which has been air-slaked, they generally lose much of their force. There is not the same disadvantage with fat lime: whether the mortars are made as soon as the lime comes from the kiln, or after it has been slaked with a little water and left exposed for some time to the air, or after the lime has been air-slaked, good results are always obtained: but we have seen that the best are got by slaking the lime with a little water as soon as it is burned, and leaving it exposed for some time to the air in a covered place. Experiments, to be given by and by, will show that I obtained good results, also, by making hydraulic mortars of sand, trass, and fat lime which had been lying wet in basins for four or five years.

We have also seen by comparison of the preceding table, that mortars made of hydraulic lime, natural or artificial, without trass or puzzalona, did not harden, with sand, until from eight to fifteen days, although giving good resistances; while those made of fat lime, sand and trass, hardened at the

same season of the year, in the space of from four to six days, and, on the average, gave much greater resistances.

These results induced me to make researches in order to the fabrication of factitious trass or puzzalona. In the following article I shall give the results I obtained—commencing with several essays that have previously been made by others, with this view.

[TO BE CONTINUED.]

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MARCH, 1837.

With remarks and Exemplifications by the Editor.

25. For an improvement in the *Platform Balance;* Benjamin Ball, city of New York, March 3.

This balance in its general arrangement, is like many others of the platform kind; the particular points claimed would require the drawing for their illustration; they do not appear to be of very great importance, but present enough of novelty upon which to claim a patent.

26. For an improvement in the *Blow-pipe for Blast Furnaces* of all descriptions; John Barker, city of Baltimore. Patent issued February 12th, 1836; re-issued on an amended specification, March 3.

The specification of this patent need not now be given, as the invention is the same with that described at page 281, as patented by John J. Hawkins, of London, Mr. Hawkins having been the agent of Mr. Barker in this business; and in England patents are always granted to some person within the realm, and issued, therefore, in the name of the agent if the inventor is not present.

27. For an improvement in the *Machine for Sawing Staves;* Jesse J. Smith, Brutus, Cayuga county, New York, March 3.

In this machine the staves are to be sawed by means of a barrel saw, attached to a vertical shaft, the teeth of the saw being downwards. Within it there is a stationary block of wood which nearly fills the interior space, but yet allowing the saw to run clear. Four spaces are cut from the bottom to the top of this block, to receive the staves to be sawed, the width and depth of these spaces corresponding therewith. The pieces of plank from which the staves are to be sawed, after being cut to the proper length, are fixed upon four carriages which are so constructed as to feed it upwards to the saw, in the proper curved direction; the staves, as they are cut, passing into the spaces prepared for them in the interior block, which, when they are separated from the log, prevent their being carried round by the saw. There are contrivances for the self-setting of the stuff on the carriages, and the apparatus appears to be generally well arranged.

The claims are to "the placing within such a saw a permanent block of wood, grooved or channelled to receive the staves to be cut, in the manner described. The position and mode of running the saw, in combination with the stationary bulged block within it, separately and distinctly from the carriages and their appendages, as constructed."

28. For an improvement in the *Mode of Moulding Candles;* John Moore and Samuel P. Bawer, Strasburg, Lancaster county, Pennsylvania, March 3.

This patent appears to be taken for an improvement upon the mode of moulding candles, invented by a Mr. Yard. There may be thirty-two moulds, or any other desired number fixed in a frame, and the candles are to be drawn from the lower ends of the moulds: the improvement consists, mainly, in four strips of wood which are to confine the wicks, form the trough for pouring the tallow, and co-operate with a stationary sliding frame in drawing the candles. The apparatus is not well described, but possibly a reference to Mr. Yard's patent might render all clear. The claims are to the manner of arranging the strips above spoken of.

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29. For a *Register and air box for admitting the air to Fire Places;* Allan Pollock, Boston, Massachusetts, March 3.

This is a contrivance intended to regulate the admission of air from without the room, to feed the fire contained in a grate. The box described may be made of cast iron, and it is to be built into the chimney in setting the grate, in such a way that the bottom of the box shall rest upon the hearth, its front edge being even with the back of the grate, and extending up from the hearth to the grate, thus occupying the ordinary position of the chimney back under the grate; this front side of the box is entirely open. The depth of it from front to back may be about six or eight inches, the back plate is to be perforated, near its lower edge, with four holes, more or less, say of two inches in diameter, which holes may be simultaneously opened or closed by a sliding register, allowing air from without the house, or from a cellar, entry, &c., to pass through the openings in regulated quantities. A lever attached to the register extends to the front of the fire place, serving to move it at pleasure. To prevent ashes, &c., from coming into contact with the register, or from being blown into the room by the entering draught, a partition extends from the bottom along the whole length of the box, about midway of its depth, and rises to within two inches of its top.

The claim is to "the register with two or more spaces, and apertures, being so placed that by moving the register the corresponding apertures in the back of the box may be opened or shut simultaneously; also the air box with the middle partition intended to change the direction of the current of air so as to prevent the dust and ashes from being blown into the room."

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30. For a *Machine for Breaking Ice,* to keep channels open during the winter; Barnabus S. Gillispie, city of New York, March 8.

A shaft is to extend across the bow of the boat, and is to be made to revolve by means of a steam engine. Upon each end of this shaft there is to be a circular saw to cut the ice, and along it there are to be jointed hammers, which by the revolution of the shaft are to break the ice so cut. The claim is to "the application of jointed hammers, or beaters, attached to the revolving shaft, in combination with the circular saws."

We doubt the efficiency of the above proposed means. The velocity with which the shaft is made to revolve cannot be such as to give much power to the hammers from their centrifugal force; their revolution with the shaft, amongst the ice must, we apprehend, be a source of great resistance and expend a large portion of the power of the engine.

31. For a *Spring Seat Saddle*; Robert Wilson, Milton, Northumberland county, Pennsylvania, March 11.

The claim is "the application to a cross straining, applied to the common riding saddle, springs which will give the cross straining the desired motion, and allow the webbing which passes under it, to rise and fall in such a manner as is required to make a pleasant seat to ride upon, using for that purpose any kind of materials which will produce the intended effect."

The springs, it is said, are so made and fixed that in case of breaking, or other injury, they can be easily replaced by others, the padding only being removed for that purpose.

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32. For a *Machine for mortising Posts, and Sharpening rails for Fences;* Wandle Mace, city of New York, March 11.

This machine bears a resemblance in several particulars to some others which have been constructed for a like purpose; its main merit consisting in the manner in which the parts are combined together so as to effect the mortising and sharpening in one machine. The post to be mortised is placed upon a carriage, and the boring is effected by, two, three, or more augers, operating simultaneously; when, by shifting the carriage, the bored part is brought under chisels in a frame vibrating vertically, which chisels remove the superfluous stuff. By means of curved chisels, or cutters, placed in the same frame the rails are to be pointed so as to fit the mortises. The claim is confined to the particular mode of construction, as set forth in the specification.

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33. For improvements in *Pumps* for raising water; Samuel Adams, Townsend, Middlesex county, Massachusetts, March 11.

Improvements, so called, in pumps, we have frequently had occasion to remark, if real, are usually very small, and to this, the case before us forms no exception, whether novelty or utility be considered. The things described are, first, the mode of attaching a leaden tube to the lower end of a wooden pump, to lead down into the water; we are apprehensive that, taking all things into account, wood will be most generally preferred to lead for this purpose. Secondly, a mode of opening the lower valve, so as to let out the water from below it, to prevent its freezing. This is to be effected by raising the pump handle to the greatest possible height, which depresses the piston, and brings it into contact with a projecting tail on the lower valve, which it tilts, and opens. Our mechanical philosophy will not enable us to perceive how this is to effect the discharge of the water, as there is not any contrivance for simultaneously opening the upper valve, a thing which we should deem necessary to the discharge of the water below, as well as above it. There has been a patent obtained for a pump in which both valves were to be opened, in a manner very similar to, though not identical with, the foregoing. This plan cannot be carried into operation in the way proposed without placing the upper and lower boxes close together, an arrangement not always to be preferred.

The claim made is to "the connecting of lead and other pipes with wooden pump barrels so as to form an air-tight junction, by means of locating the lower box in a socket connected with a pipe as aforesaid within the pump barrel, and other means as aforesaid; and the letting off the water to prevent freezing, by means of the lever valve in the lower box, opened by the projection in the bottom of the upper box, all as aforesaid."

34. For improvements in *Cooking apparatus;* William W. Parrott, Boston, Massachusetts, March 11.

This apparatus is, mainly, an open grate, or range, with ovens in the jambs, and a platform behind and above the level of the fire, upon which cooking utensils may be placed. The claim is to "the oven constructed, placed, and heated, as above described, with such a grate as above described, with such a platform at the top of the grate, and ovens as above described." In every thing which is progressive, and which in its progress slowly changes its character, it is always difficult, and sometimes impossible, to mark the precise point of change. Such, manifestly, must be the case with many of the inventions brought before the Patent Office; a strong doubt frequently exists whether a patent ought to be granted, and not unfrequently this doubt is all that turns the scale in favour of the applicant; the foregoing was a case in point, and the claim, therefore, was limited to the special mode of construction, *as described.*

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35. For an improvement in the *Truss for the cure of Hernia;* Elijah Jaquith, Brattleboro', Windham county, Vermont, March 11.

The improvement claimed consists merely in the arrangements made for causing the pad to bear against the ruptured part by the action of a helical spring. The mode proposed is equally good with many others which have preceded it, and the arrangement of the parts is believed to be new.

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36. For improvements in the *Scythe Sneath;* Dexter Pierce, Montague, Franklin county, Massachusetts, March 11.

The claim is to "the constructing the nib or thole irons and woods so as by the extension of the iron beyond the wood, with a screw and nut to regulate and fasten the nibs, or tholes to the sneath, in any situation desirable, and the method of bushing and staying the spotting, as set forth."

The improvements may be very useful, but they are not of a kind to justify an extended description in our pages.

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37. For an improvement in the mode of *Dressing the stones of portable and other mills;* Nathan Jacobs, Newark, Licking county, Ohio, March 11.

The claim made will sufficiently set forth the nature and extent of the improvements; it is to the "dressing a large portion of the face, towards the periphery, perfectly flat, while the other part, interior to this is slightly concave and furrowed in the manner set forth."

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38. For a *Rail-Road Stop;* Thomas J. West, Whitehall, Caroline county, Virginia, March 11.

What is called a rail-road stop, is a pit, or excavation constituting an open space between and under the track rails, on each side of the crossing of a lateral road. These pits are to be at least three feet wide, which width, it is supposed, will be sufficient to prevent cattle from jumping across them. The depth is to be at least two feet, but in situations where the road is elevated above the surrounding ground, the depth need not be limited. Suitable supports are to be placed underneath to sustain the track, and to give permanence to the structure. Lattice work, it is stated, may be placed above the pit; the openings in which must necessarily be such as will pre-

vent horses, or other animals from walking over them. The fence of the lateral road must, of course, reach to the pit, or excavation under the rails.

"The form and shape of said open bridges, or road stops, may be made in any mode which the convenience or fancy of the constructor may suggest; the petitioner claiming the principle herein set forth, and its adaptation to the invention, as the ground of his prayer for a patent."

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39. For improvements in the mode of *Constructing and loading fire arms;* Thomas McCarty, Elmira, Chemung county, New York, March 11.

The main feature of this invention is the employment of a metallic tube to contain the load, which tube is to be slipped in at the breech of the gun, such tube having a lateral tube, or arm, at its back end which, when in place, projects beyond the barrel so as to receive a percussion cap. When the gun is to be loaded, a stirrup, which swivels upon pins on the side of the barrel is raised, which admits of the removal of the discharged tube, and the substitution of a new one.

The claim is to "the manner of loading the gun by the use of a tube containing the whole charge, with the arm reaching out so as to be fired by an outside lock, or otherwise; which tube remains until the load is discharged, then to be replaced by another similarly loaded; and also the manner of securing the tubes by means of the stirrup. This invention is equally applicable to the rifle, the musket, the shotgun, pistols, or cannon."

It was known in the office, when this patent was granted that tubes for containing the load, and which might be carried as catridges, had been used in guns of a particular construction; it is now believed, however, that they had been employed in various ways, which were not then known, The patentee, it will be seen, is limited to his own mode of application, and this possibly may be new. Whether the plan will wear well, however favourably it may be thought of at first, may be fairly doubted; it will require no little care to prevent corrosion and foulness, to an extent which will interfere seriously with the use of the tube in such a gun.

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40. For a machine for *Making and turning the heads of Wood Screws;* Thomas W. Harvey, Poughkeepsie, Dutchess county, New York, March 25.

It would require very complex engravings to make known the construction of this and the next following machine; the claims made refer to points of construction not to be understood from verbal descriptions, and it would be useless, therefore, to insert them. The main object of the present machine, is to carry on the nicking and turning simultaneously, which operations have heretofore been performed separately, and in distinct machines.

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41. For improvements in a machine for *Cutting and Heading wire,* for the manufacture of wood screws, Thomas W. Harvey, Poughkeepsie, Dutchess county, New York, March 25.

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42. For improvements in the *Machine for Sawing Shingles, Clapboards, Laths, and various other species of lumber;* Apollos Wilbur, Burrilville, Providence county, Rhode Island, March 25.

In this saw mill there are various contrivances for sawing stuff by sin-

gle saws, and by gangs of saws, as may be required. For sawing shingles and clapboards, there is a double carriage to sustain the stuff, the upper carriage rocking upon the lower for sawing feather-edged stuff; and also working upon a pin so as to allow the upper carriage to be placed obliquely to the lower, longitudinally, to give the requisite slope to shingles, &c. There is also a saw for cross-cutting, which when not in use, stands in a vertical position, but can be brought down at any time, to cross-cut the stuff, into the required length. The claims made are, generally, to the particular modes adopted of effecting the proposed ends. But besides these, there is a claim to "the particular manner of forming head and tail blocks in three or more thicknesses," in which the stuff is to be cut from plank, the grain crossed and the whole bolted or pinned together; there is likewise a claim to dogs for holding the stuff, consisting of tubular bolts, the holding ends of which are formed into teeth, to be driven into the log, and which, it is believed, will hold firmly without tending to split it; there are some minor claims, which we pass over.

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43. For an improvement in *Spring Saddles*; John G. Manlove, Bainbridge, Ross county, Ohio, March 25.

A bow formed spring is attached to the head of the saddletree, extending forward to the distance of six inches or more. The straining girth is attached in front to a roller affixed to this spring, and extending back in the usual way, the claim is to the combination of the spring with a horn, or upright which covers and in part sustains it, with the roller in the way described; which way is not very clear.

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44. For an improvement in the process of *Burning Lime*; Samuel Garber, and H. Swartzengrover, Norristown, Montgomery county, Pennsylvania, March 25. (See specification.)

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45. For improvements in *Stove Pipes and Drums*; Merrit Bradford, Saugerties, Ulster county, New York, March 25.

This invention is intended to increase the heat given out by stove pipes and drums, by arresting it in its passage to the chimney. The method adopted is the insertion of a number of tubes in the pipe, crossing it from side to side, and open at both ends, so that the air of the room may pass freely through them, and become heated. The tubes may cross the axis of the pipe, or there may be two or more in the same plane of its cross section, "by which means" says the patentee, "currents of air will be established; the surrounding atmosphere, by the known laws of nature, will enter the lower extremity of the tube, become heated in its passage through the tube, and pass off at the upper extremity." The claim is to "the insertion of said tubes into stove pipes, and drums, perpendicularly, horizontally, or at any angle which may be desired."

We are very apprehensive that the known laws of nature will do but little in causing currents of air to pass through these cross tubes; we judge not only from some acquaintance with the particular law referred to, but from our practical knowledge of the little effect produced by some analogous contrivances.

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46. For improvements in the *Machine for Cutting the threads of*

Wood Screws; Jacob Sloat and Thomas Sprengsteen, Ramapo, Poughkeepsie, Dutchess county, New York, March 30.

This machine is in the same predicament with those referred to in No. 40 and 41. That is to say, any attempt at verbal description, would lead us far beyond the mark at which we aim, and would be read by few, and by fewer comprehended without the drawings accompanying it.

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47. For an improved *Machine for Cutting Brads and Nails;* O. P. Randand Joseph Berry, Newmarket, Rockingham county, New Hampshire, March 30.

This machine is to cut two brads by one revolution of the crank shaft which works the cutters, two of which are placed near together in the same slide. The plate to be cut is fed up by two rollers which receive their intermitting motion through the intermedium of a rag wheel, and feed arm, moved by a crank shaft. The two cutters are so placed as to cut the brads alternately to the proper slope, in reversed directions, and out of each other. The claim is to the particular arrangement described.

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48. For improvements in the machinery for *Packing Flour in Barrels*; Oliver Jewell, Rochester, Monroe county, New York, March 30.

A rod, working vertically, and having a packing piston on its lower end, is common to this and many other packing machines; the proposed improvement, consisting principally in the manner in which the piston and its rod are worked up and down, which is effected by an eccentric groove in the face of a wheel, which wheel revolves on a strong shaft; the piston rod having a slot, to allow the shaft to pass through it, whilst the rod may still work freely up and down. The wheel which is to work the piston may be two feet in diameter, and the groove in its face, a circle of sixteen inches so cut as to receive a friction roller which is firmly affixed to the rod, just above the slot. The circular groove is to coincide at one point, with the periphery of the wheel, and when the latter revolves, the piston will rise and fall to the distance of eight inches. Where the two peripheries coincide, there is an iron door, shutter, or slide, which may be opened to let the piston roller pass out of the groove, the wheel may then continue to revolve without acting upon the piston. This wheel may be placed in an apartment above the packing room.

Claim. "I do not make any claim to the several individual parts which I have described, as they constitute parts of other machines, for the same or other purposes; all that I claim as new, and wish to secure by letters patent, is the application of an eccentric groove, upon the face of a revolving wheel, to work the rod and piston of a machine for packing flour; the whole constructed, combined, and operating, substantially in the manner herein set forth."

We have heard a very good character of the operation of this machine, from those who have seen it in actual use; a much higher, indeed, than we had anticipated.

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49. For a improvement in the spring for *Spring Seat Saddles;* Henry Sheetz, Staunton, Virginia, March 30.

If the rider becomes galled in his seat, it will not be because there are not spring saddles in sufficient variety, which we are assured are patent

preventatives. Some of them, it is true, bear so near a resemblance to each other, that a choice between them may be a matter of some difficulty, and one in which we can render but little aid from the very circumstance of their near resemblance. The spring in the saddle of Mr. Sheetz, is to be of the zigzag kind, attached to a frame, of a peculiar construction, and acting by means of the straining girth, in a way sufficiently different from others, to establish a claim to novelty. He tells us that, "the advantages which this spring has over all others in use, is the great strength and permanency, combined with elasticity, of the zigzag spring, secured to it by machinery, regulating the action of the spring, occupying but little space, and being easy of construction and durable, I do not claim the zigzag spring as my invention; but what I do claim, is the improvement produced by the invention and application in the mode above specified, of the double sliding frame, regulating the action of the spring."

50. For a *Straw Cutter;* Henry Silliman, Perry Village, Gennessee county, New York, March 30.

This straw cutter is peculiar in its construction, presenting in this respect more novelty than is usual in machines for this purpose. The part in which the straw is to be placed, consists of a hollow cylinder standing horizontally upon a suitable frame. The interior of this cylinder is to be divided into several compartments, say four, by partitions running the whole length of it. The cross section of each compartment, would in this case, be a quadrant; but the inner angle of this quadrant is cut off in consequence of the passing of a screw, through a tube or case occupying the axis of the cylinder. The cutting knives are fixed upon the face of a wheel at one end of the cylinder, which is open, and as this wheel revolves, the screw with which it is connected, also revolves, and carries a nut which moves back and forth within the centre tube. From this nut, rods project out at the back end of the cylinder, which rods are received and attached to pistons, or followers, which fill the compartments, and serve to force the straw forward. Each compartment is furnished with a door, which is opened to supply the straw when requisite. The cylinder may be turned round in its frame, to bring the doors successively to the top.

The claim is to the manner of acting upon the pistons, by which the straw is fed to the cutting knife, or knives, by the intervention of a revolving screw, carrying a nut backward and forward, and with it the rods and pistons, substantially in the manner and for the purpose set forth.

51. For improvements in the *Metallic Pistons for Steam Engines, Pumps, &c.* John Swainson, City of New York, March 30.

The main object of this improvement is to allow the steam, or other fluid, to pass into the piston, between the upper and lower plates, so that it may act upon the interior of the packing with a force equal to that of the pressure on the outside. The application of this principle is not new, having been made the subject of a patent by Mr. Hall of Bassford, in England; it is therefore, to his particular mode of effecting this, that the patentee of this improvement is confined. The claim is to "the mode of placing a middle plate in the piston head, as described, and the combination therewith of the two outer plates, which contain openings through which the steam may pass in behind the whole inner surface of the packing, and press

it out against the cylinder, with a force equal to the pressure of the steam or other fluid."

The piston is described as consisting of three plates, a middle one which is solid, and always retains its place, and a lower and upper plate, adjustable by screws, each perforated to admit steam between it and the middle plate. The packing is to consist of metallic rings, breaking joints, and from the mode of fixture the packing of each segment, is pressed by the steam alternately at the return of the stroke.

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a Patent for an improvement in the process of burning lime; granted to SAMUEL GARBER AND HENRY SWARTZENGROVER, *Norristown, Pennsylvania, March 25th*, 1837.

To all whom it may concern, be it known, that we Samuel Garber and Henry Swartzengrover, of Norristown, in the State of Pennsylvania, have invented an improvement in the process of burning lime; and that the following is a full and exact description thereof.

We take a kiln of either of the ordinary constructions for the burning of lime, and we adapt thereto any of the various kinds of blowing apparatus used for forges, or for furnaces, and after having charged our kiln with limestone and fuel in the usual way, and ignited the fuel, we introduce a blast of air into the same, giving to the blast such a degree of force as may be found requisite. The blowing apparatus which we prefer, is the ordinary fan-wheel, as it affords, at once, a more diffused blast than that from bellows, or from blowing cylinders; but by the adoption of proper means, well known to machinists, as by blowing into a regulator, and by introducing the blast through several openings as large as may be found convenient, the blast may be sufficiently diffused from any blowing apparatus.

It is well known to those persons employed in the business of burning lime, that the operation of a kiln is much influenced by the state of the weather, the fuel sometimes burning too feebly to produce a sufficiently high temperature, but by means of the artificial blast, the process is made to go on independently of the atmospheric changes, and the proper temperature is rapidly attained. By this procedure, the saving of fuel is large in amount, as the proper degree of heat can not only be produced but also maintained, until the calcination is completed; and furthermore, we are enabled to burn such fuel as would either be thrown away, or would be rejected as unsuited to the burning of lime in kilns without the blast.

We do not claim as our invention any particular kind of blowing apparatus, nor any particular manner of constructing a lime kiln, but employ any of those now in use, which may be adapted to our purpose; all that we claim being the introduction of wind into a lime kiln, by a blowing apparatus, for regulating the combustion of the fuel and, in consequence, the calcination of the lime.

SAMUEL GARBER,
HENRY SWARTZENGROVER.

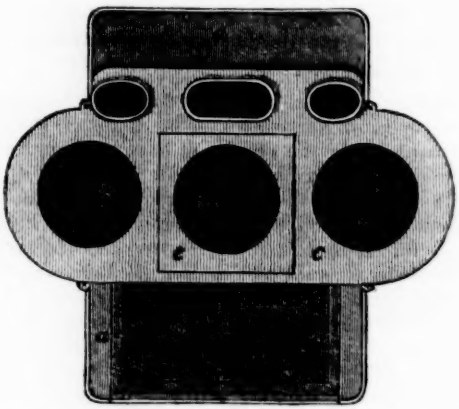
Specification of a Patent for an improved Cooking Stove; granted to JAMES N. OLNEY, *City of New York, November 20th*, 1837.

To all whom it may concern, be it known, that I, James N. Olney, of the City of New York, in the State of New York, have invented certain im-

provements in stoves used for cooking, which though intended principally for anthracite, may be used with other coal, or with wood; and improvements also in the manner of constructing and combining an elevated oven therewith. And I do hereby declare that the following is a full and exact description thereof.

Fig. 1 in the accompanying drawing is a plan, or top view of my stove, the elevated oven being removed. Fig. 2 is a front elevation of the stove, with the elevated oven. Fig. 3, an end view of the same, and Fig. 4, a vertical section thereof through the middle, from front to back.

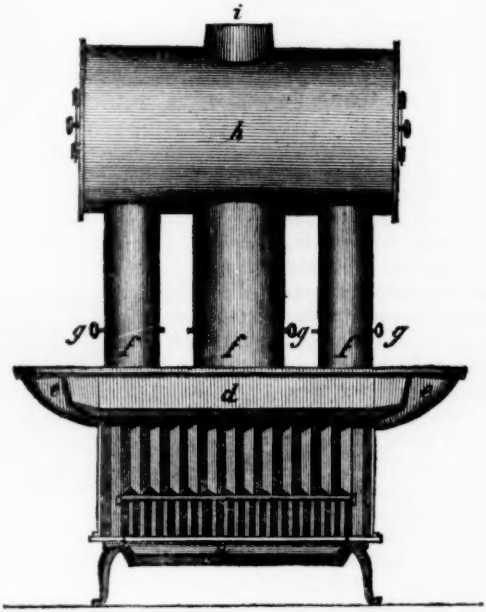
Fig. 1.



The bottom plate of this stove extends out in front so as to form a hearth, *a*, fig. 1, with a sunken ash pit *b*, as in many other stoves; it has also a hearth *á*, projecting out at the back, serving to sustain a tin roaster, or baker, which may be placed in the recess formed by the projecting of the end plates, and of the top of the stove,—*c*, is the top plate, having boiler holes *d*, *d*, *d*; the centre one of which is made in a square plate *e*, which may be removed for the purpose of placing a gridiron over the fire, which gridiron may have a tin cover, with a pipe to conduct the fumes into one of the openings or flues of the stove. The openings *f*, *f*, *f*, are to receive draught pipes, which communicate with the elevated oven, shown at *h*, fig. 2 and 3. In this latter figure *a*, is the ash pit, and *b*, the front bars of the grate, forming the lower part of the chamber, which is to contain the fuel; these grate bars have an elevation of about four inches, extending up to the corrugated, or zig-zag plate *c*, which forms the front of the fire chamber, its lower edge being five inches above the hearth. One of the grate bars is seen at *b*, in the section, fig 4. The end plate *b*, fig. 3, is formed with a recess, to receive a lining of fire bricks, and the back also is lined as shown at *e*, fig. 4, and the back plate being recessed for that purpose. In this last figure, *a*, is the fire chamber, which with the back lining *b*, and the zig-zag, corrugated plate, seen in profile at *c*, forms the whole depth of the body of the stove, which it will be seen is much less than the width of the end plate *b*, fig. 3. This extra width is occupied by a front and a back recess, formed by the hearths, the projections of the end plates, and of the top of the stove, thus contracting the fire chamber within proper limits. The vertical edges of the end plates are shown by the lines *k*, *k*; and the manner in which the top

projects in front and back is shown at *d* and *g*, which form spaces above the fire chamber, the front projection being shown also at *d*, fig. 2. This space is again enlarged at each end, by the swells *c*, *c*, on each of the end plates (figs. 2 and 3.)

Fig. 2.



The elevated oven *h*, fig 2, I make cylindrical, forming it of two concentric plates *h*, *h*, fig. 4, into the space between which the pipes *f*, *f*, *f*, (figs. 2, 3, and 4) lead. These pipes are furnished with dampers *g*, *g*, to regulate the heat. In stoves of a small size, two outer pipes *f*, *f*, will suffice, but in the larger kind it will be found best to have three, as giving a more perfect command of the heat. These pipes should elevate the oven above the ordinary height of cooking utensils, which will in general be effected by a length of about fourteen inches. The collar *i*, on the top of the oven, should be placed in the centre, as shown in the drawing, as the heat may then be best regulated.

The ends of the oven I make of cast-iron, the cylinders being of sheet-iron. A cast-iron rim, or ring, is furnished with flanches which receive the cylinders, rods passing through the spaces between the two cylinders, to confine the rims in their places. At each end, occupying the spaces within the rims, I place a cast-iron door, provision being made for suitable hinges and latches; a shelf, or plate, of sheet-iron, *j*, fig. 4, which should be perforated with holes, stands an inch or two below the centre of the oven; this can be removed when desired.

The sliding plate which covers the ash pit, or sink, in the front hearth, is so constructed that a flap attached to it may be made to cover the grate bars in front, so as to convert the fire chamber into a close stove, and this is combined also with a sliding shutter, or damper, causing this apparatus to operate as a blower, and to regulate the draught with the utmost nicety. This arrangement is shown in figs. 6 and 7.

Fig. 3.

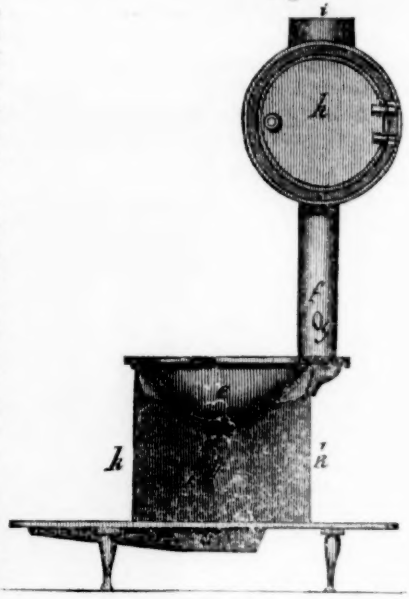
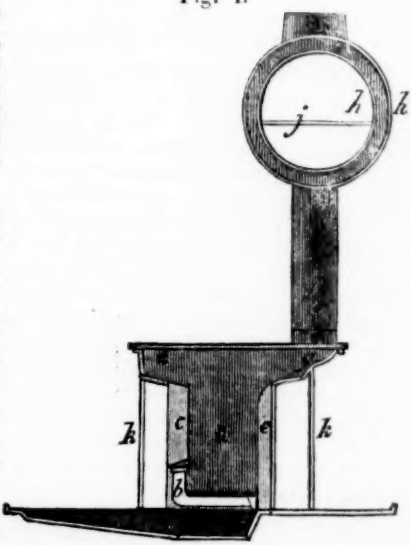


Fig. 5 is a top view of the sliding plate, and *a*, *a*, *a*, are openings through it, towards its back edge: instead of several openings, as represented, there may be one only, of any required length. A sliding damper, furnished with a rod, which may extend forward under the sliding plate, serves to regulate this damper, so as to open or close the aperture, or apertures, to any extent. To the back edge *d*, of this sliding plate there is hinged a flap, which, when down, covers the openings *a*, *a*, and their damper, and is of such width that when up it shall reach to the corrugated plate, completely enclosing the grate bars. This flap is shown at *b* in the edge view, fig. 7; when down it falls into the recess *c*, so as to be flush with the general surface of the sliding plate. Fig. 5 is a section of what I have called the zig-zag, or corrugated plate.

Fig. 4.



What I claim as my invention in the within described stove and elevated oven, is the constructing of the stove with the combined front and back recesses, formed by the two hearths of the bottom plate; the projection in front and back of the two end plates, and the widening of the fire chamber, immediately under the top plate, as herein fully set forth. I claim also the arrangement herein described, by which the grate bars in front may be

enclosed by means of a plate, or flap, hinged on the back edge of the sliding cover of the ash pit, and the combination therewith of a sliding damper, covering openings in said sliding cover, substantially in the manner

Fig. 5.

Fig. 6.

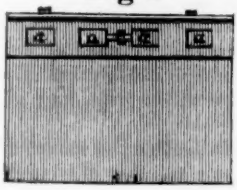


Fig. 7.

and for the purposes set forth. I do not claim the forming and placing of an elevated oven above a stove, with pipes or flues leading therefrom to the space surrounding the oven, this having been before done; but I do claim the combining of a stove such as is herein described, with a cylindrical oven, having doors at each end, the whole connected and arranged as above shown, such construction and arrangement being as I believe, essentially new.

JAMES N. OLNEY.

Franklin Institute.

Quarterly Meeting.

The Fifty-fifth Quarterly Meeting of the Institute was held at their Hall on Thursday, October 19, 1837.

Mr. JOHN GILDER was called to the chair, and

Mr. JOHN S. WARNER appointed Recording Secretary, pro. tem.

The minutes of the last meeting were read and approved.

Donations of Books were received from Messrs. Carey & Hart; the Philadelphia Library Co.; Edward C. Biddle; B. H. Hollingshead; Prof. A. D. Bache, of Philadelphia; Western Academy of Natural Sciences, St. Louis, Missouri; Thadeus B. Wakeman, Esq., of city of New York; James E. Mitchell, Esq., of Harrisburgh, Penn.

Isaiah Lukens, Esq. of Philadelphia, presented specimens of Iron Ore.

Messrs. E. & T. Fairbanks of St. Johnsbury-plains, Vermont, presented a scale for the use of Druggists, Grocers, &c., graduated to half ounces.

The Actuary laid on the table the periodicals received in exchange for the Journal of the Institute during the past quarter.

The quarterly Report of the Board of Managers was read and accepted; and on motion, referred for publication.

The Treasurer presented his Quarterly Report of the Finances of the Institute which was read and approved.

(Extract from the minutes.)

JOHN GILDER, *Chairman.*

JOHN S. WARNER, *Rec. Sec. pro. tem.*

The fifty-fifth quarterly report of the Board of Managers.

In presenting the fifty-fifth quarterly report, the Managers have the gratification to state that, although the period embraced by it has not been marked by the commencement of any new undertakings on the part of the Institute, the several sub-divisions of scientific and practical subjects placed in charge of the Committees of the Board, have received all the encouragement that the means of the society would allow.

The interesting investigations of the causes of explosions in steam boilers, have been concluded, and the general government and the community, put in possession of the valuable results of these experiments and ample directions and cautions, tending to prevent the frequency of such lamentable accidents.

The final report of the committee, on the value of water as a moving power may be expected at an early meeting of the Institute, and the practical mechanic will have no cause to regret the delay, which has attended its completion, when he reflects on the vastness of the subject under examination, and the more than imperfect theories, heretofore, at his command, in the published treatises relating to it. The experiments made under the authority of the Institute, were of the most perfectly practical character, and while no attempt will be made to sustain a preconceived theory in relation to the best mode of applying water as a moving power, the applications of a sound theory, deduced from actual practical results, will be put at the command of those interested in the enquiry.

The committee on Science and the Arts, have been sedulously prosecuting the inquiries and examinations requested of the Institute, by inventors and others whose pursuits are benefitted by such investigations, and the Board refer to their report herewith presented, for a detailed exhibit of their transactions.

The committee on the New Hall, have not yet been able to obtain a sufficient amount on loan to warrant the removal of so much of the Masonic Hall, as may be necessary to commence the construction of a new edifice for the accommodation of the Institute; but although disappointed in their reasonable expectations, they are not yet so much dismayed with the prospects before them, as to recommend any thing but renewed and cordial exertions, to accomplish an object of such vital interest to the Institution. Up to the present time, at a comparatively small sacrifice of the active means of the society, all the pressing demands connected with the purchase have been met, and the Board, on the recommendation of the committee, have directed subscriptions to be received for the Stock of the loan, heretofore authorized, in such sums as will be found entirely convenient to every member of the Institute. The Board invite the attention of the members to the plan, as at once combining the advantages of a safe and productive Saving Fund, and enlarging and sustaining an institution, devoted to the cause of sound science, and the promotion of the mechanic arts.

The department of instruction, has received that attention which its important bearing on the stability of the Institute demands. Arrangements are in progress, for the commencement of the regular courses of Lectures on Chemistry, Natural Philosophy and Mechanics, and on the applications of science to various arts and trades.

To these the Board at present have the prospect of adding a series of volunteer lectures, on such collateral branches of science as are of general

interest, and they hope that the exertions of the committee, will be met by a corresponding attention in the members.

The course on Chemistry, will be conducted by Professor Mitchell, whose valuable aid in that department we have now enjoyed for several years, and at a sacrifice to his personal interest, which can only be compensated by the satisfaction we know he feels in sharing with his fellow citizens his vast and profound attainments in the beautiful science to which he is devoted.

By the resignation of Professor Johnson, the Institute has lost a zealous teacher of Physical Science, whose appointment to an important station in the Exploring Expedition, now being fitted out by the general government, will afford an ample field for the exertion of his industry and research, which we have so long enjoyed in our connection with him as an associate and Professor.

The department of Natural Philosophy and Mechanics, has been confided to Mr. John C. Cresson, a gentleman already favourably known to many of the members, and from whose devotion to these practical branches of education the Board anticipate a success honorable to himself and advantageous to the Institution. Mr. James C. Booth, whose valuable services we have enjoyed for the past two years, will continue to conduct the lectures on the applications of Science to the Arts; the department is one which the Board is most anxious should command the attention of the members, as it brings down to the actual walks of life, those almost unseen connections, which profound science maintains with manufacturing and domestic industry, and the extensive cultivation of a knowledge of this connection must lead to great improvements in what is now the mere routine of the factory and workshop.

The Drawing Schools of the Institute, were opened on the 17th inst., the department of Mechanical and Miscellaneous Drawing, under the care of Mr. William Mason, and that of Architecture and Practical Carpentry, in charge of Mr. John McClure. Both these gentlemen are teachers whose efficiency in their profession have been fully tested by the experience of the Board, and they have no hesitation in recommending them to all who desire instruction in the branches they teach. The accommodations for these schools, have been much enlarged and they are possessed of every convenience for the reception of a numerous class.

In addition to the usual augmentations of the Library, by purchases and exchanges, about one hundred volumes have been received from our esteemed member, Professor Bache, President of the Girard College, now in Europe. These books have been purchased out of a fund, placed in in the hands of Dr. Bache by the subscription of the members, and having been selected by a mind distinguished for its discrimination and devoted to practical science, are great acquisitions to our collection. Some additions have been made to the Cabinets of Models and Minerals; they are gradually obtaining their proper hold on the attention of the public, which leads us to hope that at no very distant day, they will fully correspond with the success of the Institute in its other departments.

The Treasurer's report of the receipts and expenditures of the Institution are herewith presented, for the information of the members.

During the quarter forty-one new members have been elected, and two resignations received. Of the new members thirty-one were associated with the Institute, by the the incorporation of the Mechanics and Tradesman's Exchange; the union of the two societies, reported at the last quarterly meeting as about to take place, having been since accomplished, and

a large and valuable accession of strength secured to the Institute, by connecting with it some of our most respectable tradesmen and mechanics, and giving an additional warrant for the perpetuity and success of our association.

JOHN STRUTHERS, Chairman.

WILLIAM HAMILTON, Actuary,

Third Monthly Conversation Meeting.

The Third Monthly Conversation Meeting of the season, was held at the Hall of the Institute, on Thursday evening, November 23rd, 1837.

The meeting was numerously attended by members and invited strangers, who availed themselves of the opportunity for social intercourse and the informal discussion of scientific and mechanical topics.

There was a very respectable display of articles of American manufacture and several newly invented machines and implements.

From Messrs. B. Slater & Co. were sent a variety of weaver's shuttles and temples, some of which are of improved construction. Also an improved satinet shuttle, broad cloth and power loom shuttles from the same gentlemen, and a governor for water wheels of compact form.

Messrs. W. H. Carr & Co. exhibited some neat shutter fasteners, made by M. M. Israel & Co. of Westfield, Con., and samples of pump augers, very beautifully finished, from the well known manufactory of N. P. Ames, of Cabotville, Springfield, Mass.

Messrs. Curtis & Hand produced samples of hollow and common screw augers of various sizes, and some highly reputable specimens of table cutlery manufactured by Messrs. J. Russell, of Greenfield, Mass.

Mr. A. C. Jones laid before the meeting a drawing of the boiler of the steam ferry boat which exploded a few weeks since at Camden, N. J., together with a part of the boiler, affording remarkable evidence of the destructive effects of explosive steam.

Mr. J. J. Hitchcock exhibited a working model of Green's patent straw cutter.

Messrs. Gleason & Griffith presented a parlour stove of neat appearance.

Mr. Jos. Harrison, Jr., presented a grate bar which he has recently devised for locomotive engines consuming anthracite. The bar is formed with a longitudinal groove for the reception of a shield of fire clay.

A machine for reeling and spinning silk at one operation was exhibited by the inventor, Mr. Adam Brooke, of Scituate, Mass. This machine has been submitted to the Committee on Science and the Arts, from whom a report may shortly be expected.

Mr. Joseph Saxton put in operation a very compact and active electro-magnetic machine of his own invention and construction.

Mr. Samuel Hufty exhibited a very pretty philosophical toy, misnamed a kaleidophone, which displays several beautiful figures formed by the vibration of wires of different forms.

Dr. Hare exhibited a species of ether, obtained by the reaction of alcohol, an acid, and a nitrite. This liquid differs from that heretofore known either as nitric, nitrous, or hyponitrous ether, in boiling at a lower temperature, in being much more volatile on exposure to the air, in having a more sugary taste, and in odour more resembling the liquid resulting from the reaction of chlorine with olifient gas. By evaporation it produced a temperature of 15° below zero of Fahrenheit. On contact with the tongue or finger it hisses as when a hot iron is introduced into water. By the process which Dr. Hare has adopted, the quantity of ether obtained is nearly equivalent

to the quantity of absolute alcohol employed; whereas, according to Thenard, the process which he recommends as the best of those pursued in Europe, affords a quantity not exceeding a fifth of the alcohol.

It is anticipated that this new process will have a favourable influence both on the quantity, and price of the sweet spirits of nitre of pharmacy.

Dr. Hare has reason to believe that he has obtained a species of ether compounded of the elements of nitric and acetic ether, and which may deserve the appellation of nitro-acetic ether.

In the usual mode of conducting the process for sweet spirits of nitre, a most acrid principle has been detected which affects the nose like mustard or horse radish. This has been isolated and is supposed to be a chlorolganic ether.

In the ordinary processes for nitric ether, or sweet spirits of nitre, not only is much of the alcohol destroyed by the excess of oxygen, but the resulting products by uniting with the nitrous ether lessen its volatility and modify its qualities.

Besides the results above mentioned, Dr. Hare has procured an inflammable gas which seems to be an ingredient of the ether above described. Hence the new ether appears at first to boil at 50° Fahr., but the point of ebullition gradually rises to 65°, and yet after having thus risen, if the ebullition be suspended and afterward re-excited, it may take place at a lower temperature than was requisite, when the suspension took place.

This gas Dr. Hare finds to be permanent at the temperature of 6° below zero Fah. By great pressure it becomes a liquid resembling in colour the liquid ether. The effect of the gas upon the organs of smell and taste resembles that of the liquid ether, and it is conjectured that the gas and liquid contain the same elements, existing in the same ratio but occupying different volumes, or in other words they are metameric.

Bibliographical Notice.

"*Annals of Electricity, Magnetism and Chemistry, and Guardian of Experimental Science, Conducted by* William Sturgeon, *Lecturer on Experimental Philosophy, at the Honorable East India Company's Military Seminary, Addiscombe, &c., &c. And assisted by Gentlemen eminent in those departments of Philosophy.*"

The editor of this new Journal has been for several years known advantageously for his skill as an experimentalist, the ingenuity of his elucidations of theory, and the accuracy of his knowledge of electrical science in its varied and increasingly extensive applications in the phenomena of matter and motion. We have had quite a treat in looking over the first six numbers of "The Annals of Electricity" and have marked several extracts for republication in our own monthly. If sustained in a manner correspondent with the volume already published, it will vie in interest with any of its cotemporaries.

We are glad to find that the encouragement it has met with has induced the Editor, in order to furnish a vehicle more adequate to the abundant materials in his possession, to change it from a quarterly to a monthly publication, commencing on January 1st, 1838. In each of the numbers published there are at least two pages of lithographed plates, executed with uncommon neatness and clearness of outline, exhibiting an extensive variety

of electrical, voltaic, and magnetic apparatus. The original communications are valuable, and the republication and embodying in one work the best essays and memoirs on this engrossing department ot knowledge cannot but facilitate an acquisiton which must be desirable to every student and teacher of science.

Progress of Practical and Theoretical Mechanics and Chemistry.

Articles from the French Journals; translated for the Journal of the Franklin Institute, by J. GRISCOM.

Pyrophorus of easy Preparation.

When two and a half parts by weight of pure tartaric acid, *deprived of its water of crystallization*, perfectly dry and reduced to powder, are mixed with eight parts of peroxide of lead in a dry capsule, it is well known that an ignition of the whole mass soon takes place, becomes very vivid, and lasts a long time. M. Böttigen has repeated this experiment with oxalic and citric acids, and finds that the action of the first on peroxide of lead is more prompt if not stronger than that of tartaric acid, and that the action of citric acid is a little weaker. By mixing five and a quarter parts by weight of peroxide of lead with one part of oxalic acid dried at a gentle heat (à l'air chaud) or containing 19 per cent. of water, an instantaneous ignition of the mass takes place, but it does not continue so long as with tartaric acid, because oxalic acid contains more carbon than tartaric. Citric acid must be kept sometime in previous fusion, then dried and pulverised, and one atom of it mixed with two atoms of the peroxide at a temperature of about 72°. The ignition of the mass is then as quick and continues as long as with tartaric acid. Minium, litharge and carbonate of lead also succeed with the latter, but less effectually than the peroxide. Jour. de Pharmacie.

Substitute for Soap.

M. Fenton, the inventor of this process, proceeds in the same manner as in soap making until the mass is ready for the moulds. He then dissolves common soda of commerce in water, and pours the solution on quick lime, taking equal quantities of soda and lime, and the mixture is boiled in a kettle. A quantity of alum equal to one half of the soda is well dissolved in water, and as soon as the contents of the kettle begin to boil, one part of the solution of alum and two parts of the mixture of the kettle are poured together into a separate vessel. This lye, at a proper temperature, will combine easily with soap. Recueil Industriel.

Separation of carbonic acid gas from sulphurous acid and sulphuretted hydrogen. By GAY LUSSAC.

It is necessary on a variety of occasions, to determine the exact proportions of a mixture of carbonic acid and sulphurous acid or sulphuretted hydrogen. I am aware that various methods have been proposed, and would scarcely venture to say that the following is entirely new, and it may perhaps be worth recommending to chemists, only from the very simple manner in which I am in the habit of applying it.

After having measured the mixture in a graduated tube, I take a rod of glass a little longer than the measuring tube, and having smeared one end of it with flour paste and rolled the smeared part in pulverized oxide of manganese, which adheres to the paste, I insert it into the tube of gas, with the powdered end uppermost. Immediately the volume of gas rapidly diminishes, and in a few minutes the absorption of sulphurous acid or sulphuretted hydrogen is complete. If either of these two gases prevail in the mixture, or if there be too large a volume to be operated on, it may be advisable to withdraw the rod, wipe it clean, renew the paste and the manganese and repeat the operation. This however is but rarely necessary,—yet it is the less objectionable as the oxide is seldom detached from the glass rod and does not soil the inside of the tube. A band of wet paper may be wrapped round the rod instead of the paste, but it takes up less manganese.

The same mode of separation may be applied to the deutoxide of azote.

Ann. de Chimie.

Observation on the Assay of Silver in the moist way. By Gay Lussac.

In the course of the assays which I am daily making at the Warrant Office (bureau de garantie) Paris, I have had occasion to observe a new circumstance which may lead some into error who are employed in determing the value of plated materials in the moist way, if they are not aware of it. It arises from the fact, that sulphuret of silver is not very easily attacked by nitric acid; so that if the silver to be tried contains a few thousandths of sulphuret of silver, it may happen that this will not be dissolved and consequently too low an estimate will be given to the assay. This will take place, however, because the nitric acid is not strong enough or is not employed in sufficient quantity. Be it as it may, when the silver contains sulphurets, and a portion of it remains undissolved in the nitric solution, which will be known by the appearance of a very fine powder, heavy, of a dark colour, and different from the gold which silver sometimes contains in being less flocculent, the addition of a fresh quantity of concentrated nitric acid, will effect the solution of the sulphuret; but I have found it preferable to add to the solution of silver, when the presence of sulphuret is suspected, the amount of 5 or 6 cubic centimetres of concentrated sulphuric acid. This immediately dissolves the sulphuret ; but to be more sure of it the nitric solution should be exposed for a few moments to the heat of boiling water.

The sulphuric acid must be free from muriatic acid. If it be not, it may be boiled for a short time, which will expel the muriatic acid; but I may say that I have never met with a sensible quantity of muriatic acid in the concentrated sulphuric acid of commerce.

Ibid.

Thermometer Watch. By M. Jurgensen.

This is not larger than a common watch. The double arches of the balance wheel are externally of platina and internally of brass; the variation of its rate of going is about 32 seconds in 24 hours for every degree of the centigrade thermometer.

This instrument, placed in the open air like a common thermometer, will have its rate of going accelerated or retarded according to the atmospheric temperature. If then it be known to what degree of temperature the watch

is regulated,—at what degree the needle beats exactly 86,400 times (answering to the number of seconds) in 24 hours, the difference between this number and the actual number of oscillations which it shall have made in twenty-four hours, will serve to show the *mean* temperature during that day, although the rate of going may have varied several times through the day. The observer then has only to compare its indications twice in twenty-four hours with a good clock or chronometer, to ascertain, the discrepancy, and convert it into degrees of the thermometer.

To render this instrument more generally useful, Mr. Jurgensen has added a metallic thermometer which gives the temperature at the moment of comparison, and by the aid of two hands the maximum and minimum during the twenty-four hours are also exhibited. Bulletin d'Encour. Mai.

Cordage of the fibre of Aloes.

According to M. Chevremont, Engineer of Mines, ropes made of aloes have four times the resistance of those of hemp of the same diameter and made by the same process. The fibres of the aloe contain a resinous substance which protects the ropes from the action of moisture even at sea, and renders the tarring of them unnecessary. They are lighter than hempen ropes, and lose nothing of their strength by being wet. When plunged into water even, they are shortened only two per cent., so that they are much less stiff than hempen ropes. Ibid.

Culture of Beets in Lombardy.

There have been some remarkable peculiarities in the cultivation of the sugar beets in this country during the three years past. Its light and sandy soil suits them well, if the temperature which undergoes a sudden change on the first rains do not too long protract the sowing. Excessive droughts are also injurious, causing the portion of the root which is above ground to become green and acrid. Irrigations, so easily made in this country, and so favourable to rice, wheat and corn, injure beets, because they submerge the plants and prevent the unfolding of the leaves. To remedy these inconveniences, M. Pagen has advised the sowing of the seeds in beds and then transplanting the roots in raised beds enriched with good fine manure, immediately after the early rains. The roots will soon strike into this deep soil, and will be less exposed above ground. Water may be conveyed into the furrows between the beds without any risk of submerging the plants and the produce will be more certain.

Last year, the temperature and moisture being unusually favourable, beets were sown early, with the drill, and the gathering was abundant. The juice marked 5° on Baumé's acrometer, after being clarified. The raw sugar had a more agreeable taste, and the molasses was very sensibly less acrid than similar products in the north of France.

A large portion of land having been covered with the alluvial sands of the Adda, the beets sown upon it were unusually flourishing, but the juice was sulphurous and furnished but little sugar. Ibid.

Machine for cutting wood into thin leaves.

Mr. Picot has patented a machine by which extremely thin leaves, may be obtained either for cabinet work, or lithography. From an inch plank,

he takes from twenty-four to thirty leaves, suitable for inlaying and as many as 170 adapted to lithography. The machine is very light, and is applicable to soft or hard wood, with an economy of one half compared with common sawings; there is no loss of wood. It can be worked by a single man, with the aid of a boy to gather the leaves as they are taken off. Its celerity is such that a thousand leaves may be cut in an hour from hard wood. Veneers from 28 to 30 inches long, and 14 to 16 wide may be cut by one or two men. Ibid.

New theodolite, by M. Gambey.

M. Arago presented to the Academy of Sciences, a theodolite which M. Gambey had just executed, and which reflects both horizontally and vertically. Such are the neatness and regularity of the graduation; that, by the aid of verniers five seconds can be read off with the greatest certainty, on the two circles, though their radii are but three inches.

M. Arago remarks, that all the parts of this instrument are executed by mechanical means; and with respect to the division, there is this seeming paradox, that the graduating circle is not necessarily placed in the centre of the platform. M. Gambey has resolved that problem with great certainty, by connecting the traces or graduates with an articulated system of remarkable simplicity. Ibid

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Triangular Sweeper for cleaning streets.

This machine is composed of a triangular frame, mounted on three wheels and furnished with three score brooms. It is distinguished from others by the brooms being attached in rows of five each, to cast iron blocks, which play freely in grooved posts. Each group of brooms rises and falls according to the unevenness of the surface, and thereby always touches the pavement. As they wear out they fall by their own weight. If the machine is to operate in front, the dirt, collected at the point of the triangle, will be thrown to the right and left, without splashing, to the distance of eight feet, and is left in heaps. If the triangle works in the rear, the dirt of the gutter will be collected in the middle and brought to the sewer.

Ibid.

(N. B. The gutters in France are generally in the middle of the streets.)

G.

New process for extracting Sugar from Beets. By M. Schuzenbach of Carlsruhe.

This process consists in converting the beets into powder or dry flower, by a method which operates at once upon large masses and at little expense. The sugar is extracted from this farina, by a very small quantity of water, which comes out clear and limpid and so concentrated, that in order to obtain a given quantity of sugar, only two or three times its weight is necessary of this concentrated and limpid fluid. The subsequent manipulation, crystalization, &c. are thereby facilitated. The greatest quantity of crystalized matter contained in the beet, is thus also procured and but little molasses produced.

The author asserts that the expense by this method, is much less than by that commonly pursued, and that his apparatus occupies but little room.

Ibid.

Beet Sugar.

It appears to have been proved by M. Parrayon, beet sugar manufacturer at Mérignies, France, that by adding diluted sulphuric acid to the pulp, as much juice can be obtained by two cold pressures as by hot pressure, and that any injurious effect of the acid is completely removed by filtering the juice cold through animal charcoal properly prepared. It passes from the filter with an alkaline rather than an acid reaction. After being filtered, it undergoes clarification by the ordinary methods, requiring, however, rather less lime than usual. The sirup is remarkably white. One litre of it (2.1135 pints) produced 970 grammes (=31 oz troy,) whereas the same quantity, by measure, of the ordinary sirup, yields only 750 grammes.

Ibid. June, 1837.

Steam Navigation to America and India.

Sir,—Since my communication which you inserted in No. 733, upon the subject of steam navigation to India, I have been informed that the "Atalanta" sailed again from Bombay on special service, with 300 troops on board, on the next day but one after her arrival at that port; thus proving the excellence of her machinery, and the possibility of continuously working a steam engine for a considerable period without injury. It places the reasonings of Dr. Lardner on this point in a very questionable shape, and affords us humble mechanics something like a reasonable hope that the passage to New York may be accomplished in *one* trip, although Dr. Lardner has pronounced it to be next to impossible.

The steam ship called the "Great Western" has arrived in the river Thames for the purpose of receiving her engines. She was built at Bristol by Mr. Pattison, and measures about 1320 tons, old tonnage; when first launched she drew eight feet eight inches water abaft, and seven feet eight inches water forward; with 600 tons of coal on board, she draws eleven feet three inches water in the river Thames, or about eleven feet at sea, which shows that the displacement of the first two feet four inches above the light water line, is equal to 600 tons, and as she may be safely put down to fifteen feet water, the next four feet will displace, at least, 1200 tons more, making her total displacement 1800 tons at the least, which may be thus distributed: 500 tons for machinery, 800 tons for fuel, and the remaining 500 tons for additional stores, merchandise and passengers. She has now the greater part of her stores on board, as cables, anchors, sails, &c. which of course leaves nearly the whole 500 tons for merchandise and passengers.

She is fitting up in a very commodious manner for the convenience of passengers. The saloon will be very lofty and airy, and the state rooms (sleeping cabins) are large and convenient. The paddle or main beams are formed of four pieces of timber, each twelve or thirteen inches square, confined together at the ends, and separated to the distance of six or seven inches on the middle of their length on the same principle as the bow beams of Mr. Smart.

Her size, when seen by herself, does not appear so great as it really is, and it is only when on board, or seen alongside other vessels, whose size is known, that her magnitude is appreciated. She is nearly as long as the large steam vessel "Victoria," now building in the river Thames, but is not so wide, nor so deep as that ship.

The East Indian Government have purchased another steam ship, the

"Waterford," to send out to India. It is said that she is to be called the "Semiramis." It is a matter of regret, that a vessel expressly built for the conveyance of merchandise should have been purchased for this purpose;—it is not giving the trial of steam communication with India a fair chance. For, although well adapted for the purpose for which she was built, she is evidently not suitable for a steam frigate or a packet. One would have thought, that with the practical experience which the East India Company must possess, as to the rapid destruction of timber from the effects of climate, &c. in their Indian Possessions, they would have selected a vessel built with the most durable materials to send out, and not one in which red pine is so largely used as in the "Waterford."

Advices have been received from the "Berenice" (the last steamer dispatched by the Hon. East India Company) from which it appears that her progress has been more rapid than that of the "Atalanta" during the same part of the voyage. I am, Sir, yours, &c.

GEORGE BAYLEY.

London, September 11, 1837. Mech. Mag.

Extraction of Silver Ore.

The study of the very gradual operations of nature has a bearing, the extent of which is far from being known, not more in a scientific, than in an economic point of view. The application which is about to be made of it in the extraction of some metals from their respective ores, particularly of silver, may here be noticed in illustration. The process most generally and longest employed in the management of minerals containing silver, consists in combining this metal with quicksilver, without the aid of heat, in a set of operations which has undergone few changes since the middle of the sixteenth century, the epoch of its discovery, and the theory of which is even now far from being well known. The amalgam is separated from the mineral by washing, and the silver from the mercury by heat. The amalgamation is effected in a viscous *magma* or lie, composed of the silvery mineral bruised into an impalpable powder, and likewise of mercury, common salt, sulphate of copper and of iron, of lime and of water, which are left to their mutual spontaneous action, whilst they are moreover frequently kneaded as it were under the hoofs of horse and mules. The different actions which are produced in this magma have been carefully examined, since those principles which were formerly neglected have begun to be studied. Since that time, the different causes which are sometimes opposed to the chloridation of the silver, and to the decomposition of the chloride by the mercury, whence losses sometimes result in the process, have been discovered. By removing these disturbing causes, and by reducing the problem, so to speak, to its most simple expression, silver has been extracted from a great number of ores, without the employment either of heat or of quicksilver, by employing sea-salt only, and some chemical products which are very easily procured every where, and iron, or iron and silver only in such a way that silver is extracted by the silver. All that is required, then, for the working of these valuable minerals is, that the localities whence they are procured be found in the neighbourhood of the sea, or of those great collections of rock-salt which are concealed in many parts of the world.

The first experiments were made in tubes which were almost capillary

and upon the most minute fractions of the ore. The results have been such, that after a few trials, experiments have successfully been made upon many hundreds of pounds. And it is now hoped that in a very short time, art will be able to avail itself of a process which, in addition to the pecuniary advantages it affords, will enable us to reduce those valuable ores, which now cannot be subjected either to amalgamation, or to the action of fire, more especially those which contain copper in great quantaties, and whose management has always been an impossibility to metallurgists.

The importance of working minerals containing silver, without the aid of mercury, will be easily appreciated, when it is known that the registers of the mint of Potosi bear witness that between 285 and 286 millions of *marcs* of silver have been struck from the year 1570 to the year 1800, and that in the preparation of this enormous sum 286 millions of pounds of mercury have been lost, which, at the present price, represent a capital of L. 62,500,000. This immense quantity of quicksilver, used at Potosi alone, is now in the bed of the Pilcomayor, a river of Peru, into which flows all the refuse and rubbish of the siver-mine. What a mine of mercury is this same, so soon as art shall have devised means for its easy and economical recovery.—*Becquerel on the relations of Natural Philosophy with Chemistry and the Natural Sciences.*

Changes of the Zero Point in a Thermometer. By M. C. Despretz.

It appears to have been satisfactorily proved by C. Despretz, that the freezing point of a mercurial thermometer, owing to changes in the structure of the glass, is constantly liable to fluctuation. Its tendency is to ascend on the scale. In experiments with two thermometers, often repeated at intervals between the 30th of August 1832, and the 23d of June 1837, the zero point of the centigrade scale rose in the one case from 0° to 47°, and in the other from 0° to 45°. Their sensibility was such that one hundredth of a degree could be estimated in one, and from two to three-hundredths in the other. This movement of the zero point is produced both by sudden heating and cooling and by the gradual influence of time. If the temperature of an instrument is kept very low, the freezing point ascends; if elevated, it sinks; and this change may be perceived even on suddenly cooling and heating the instrument. Thus, if the freezing point of water be taken, then the boiling point, and then again the freezing point, the latter will be found depressed below its former mark, by a quantity or space which ought not to be neglected in nice experiments, for it sometimes amounts to a third of a degree even in thermometers with a small reservoir.

Whenever, therefore, the determination of fixed temperatures is an object of experiment, the position of the zero ought to be previously ascertained; but if the object is only an estimation of differences of temperatures the oscillations of the zero may be disregarded, since the value of each thermometric degree depends only on the mass of the quicksilver (which remains absolutely the same) and on the co-efficient of the dilatation of the glass which cannot have varied by an appreciable quantity. In these cases we may dispense with taking the zero.

Science presents facts which appear somewhat analogous to the changes in glass now alluded to. Pietet shewed in 1816 that a bar of iron about an inch in diameter and a little more than 100 inches in length, pressed or strained by a weight of 260 pounds, did not return exactly to its primitive length when the weight was removed; and that this was also the case when

it was heated or cooled, the bar always remaining too long or too short after returning to the primitive temperature. The fact of the rupture of a bar, under a weaker load than that it had before resisted, is of the same kind. Various observations of M. Savart on torsion may be referred to the same principle, as well as another fact alluded to by him, viz. that a roll of sulphur gives sounds more and more sharp, for a certain length of time. Do not all these facts concur to prove that every time the molecules of a solid body undergo a displacement by any mechanical cause, as pressure, attraction, or torsion,—or by a physical cause, as an elevation or depression of temperature, they do not resume exactly their primitive positions when the causes have been removed. Annales de Chemies.

The changes in the interior arrangements of the molecules of a body, brought into view by the forgoing extract, are not without an application to the usual mode of trying the strength of steam boilers, the process commonly resorted to being mechanical, and not by the agency of heats. Tr.

Gas Coke as a Fuel for Melting Iron.

The following communication possesses much interest for all concerned in the manufacture or use of iron casting. In the preparation of this material, time is emphatically money, and the experiments at the Franklin Works show that a saving may be effected of one-half the time usually required in melting. Com Pub.

Franklin Works.

Philadelphia, January 1, 1838.

Dear Sir,—At the suggestion of Mr. Cresson, Superintendant of the Gas Works, we made, some weeks since, a few trials of gas coke as a fuel for melting iron. They were not made with reference to exact results because having never heard of gas coke being used in England for this purpose, we doubted the success of the experiments.

A few days, however, convinced us that the coke presented advantages over the anthracite which would render it an important fuel for iron founders, and we determined upon making some exact comparative experiments upon the use of the two fuels. The results of which we deem it proper to send you with liberty to make such use of them as the Board may deem expedient.

Our cupola is thirty inches in diameter. The blast is urged into it by a fan with four wings having an agregate area of 384 inches of fan surface moving 1800 revolutions per minute through three tuyeres, two of them 4½ inches in diameter, and one of 5 inches. The aggregate area being fifty-one inches and a half.

The trial was made in two heats with each kind of fuel and the results given are the aggregate of both heats respectively.

1st. *Anthracite Coal*, white ash of very excellent quality,

Time of blowing	1st heat	3 hours 15′
	2d "	3 " 30
	aggregate	6hs. 45′ or 405 minutes.
Metal melted	15.464 lbs.	or 2300 lbs. per hour.
Fuel used	2.300 "	or 470 lbs. to the ton of iron.

2d. *Coke.* Time of blowing 1st heat 1hr. 54′
2d " 1 18′

aggregate 3 12′ or 192 minutes.
Metal melted 14.342 lbs. or 4450 lbs. each hour,
Coke used 3.056 " or 470 " to the ton of iron.

The weight of fuel used to each ton of iron melted, was in both cases precisely the same, but the quantity melted in the same time was nearly double. The importance of time in a shop where many hands are employed, can readily be appreciated and would of itself be a sufficient inducement to ensure it a preference even at an advanced cost.

The capacity of a cupola for large castings is increased in proportion to the increased rapidity of melting—while with the anthracite our operations were confined to castings weighing not more than from 30 to 3500; we should have no hesitation of undertaking a piece of work weighing from three to four tons from our cupola using coke as fuel.

MERRICK & AGNEW, Iron Founders, Southwark.

Dr. R. M. Huston, *President Philada. Gas Works.*

Gowland's Artificial Horizon.

Sir.—At the late meeting of the British Association, in Liverpool, Mr. William Ettrick gave a description of several artificial horizons; among others, of one invented and constructed by himself. This instrument consisted of a black glass plane, with a pendulous rod attached to the under surface, and was supported by centres playing in gimbals. The rod had a weight affixed to its lower end, for the purpose of maintaining the horizontal position of the plane.

Under these circumstances I deem it right to state, that in the early part of the year 1835, Mr. Gowland, chronometer maker, of Leathersellers Buildings, London-wall (the ingenious inventor of the triple-pointed steel pens, &c.,) showed me an artificial horizon which he had introduced, consisting of a flat plate of opaque black glass, which floated upon the surface of mercury contained within a circular box, somewhat resembling a large tobacco-box. The glass was of a very beautiful jet black colour, and was levelled with extreme care, the positive efficiency of the instrument mainly depending upon the accurate parallelism of the two faces. Suspended by centres, moving in gimbals, with a weightier rod screwed to the bottom of the box, this horizon, would be adapted to use on ship-board. For the purpose of land-service, however, the plumb-rod is unnecessary, the instrument being complete in its original simple and compact form. The portability of Mr. Gowland's artificial horizon, with the circumstance of its requiring no verification or adjustment previous to using, sufficiently accounts for the high value that has been attached to this instrument, and justifies the preference it has attained over some other inventions of a similar nature.

Extraordinary care must of necessity be used in affixing the pendulous rod to Mr. Ettrick's glass plane, so as to obtain a true horizon, and I apprehend it must be liable to derangement in use. In Mr. Gowland's apparatus no such nicety is required; *self-adjustment* always takes place.

The tremulous motion of the mercury, which is so decidedly objectionable to its use for a reflecting surface, is nullified by the superincumbent plane of glass, while the true horizon is always obtained without trouble, and with great certainty.

WILLIAM BADDELEY.

Wellington street, Blackfriars road, Sept. 26th, 1837. Mech. Mag.

Progress of Physical Science.

Optical Illusions.

If we consider for a moment, in what way we may distinguish a concave from a convex surface, we shall find that it merely consists in a different distribution of light and shade; those parts which are light in the one, being shaded in the other, and *vice versâ*; the deception produced in objects of this form, by inverting the position of the image, is most striking, and affords one of the best instances of the fallacy of our reasoning, when we lose one of the data on which we ground our inferences.

If we take any bright convex or concave surface, no matter what the material, and place it between the window and the eye, so that the eye sees it by looking *downwards* at an angle of from 20° to 60°, there is a certain distribution of light and shade on the object, which enables the eye, from habit, to determine whether it be convex or concave; if we can now invert the position of the edges of the object, with reference to the eye and the window, the shaded parts assume just the position which would be assumed by the opposite curvature; now, this inversion may be done without any lenses whatever.

Take a common Wedgwood-ware evaporating-dish, or a common tea-saucer, a basin, or any object which is concave on one side and convex on the other—a watch-glass even will do—and place it on a table between the observer and the window, with the concave side upwards, then hold a piece of common glass (with the under side blackened) in such a position that an image of the object will be reflected from its surface to the eye: the laws of optical reflection teach us that the rays from the farther edge and those from the nearer edge cross each other in their passage to the eye, and assume an inverted position, it will now be seen that the object has every appearance of being a convex surface, and if the angle of observation be well chosen, (which depends partly on the height of the window,) the illusion is so strong that it can scarcely be removed from the mind. If a convex mirror be substituted, and its position well adjusted, the distortion will present all the appearance of a concave mirror.

It is not essential to this experiment that the reflector should be black on its under surface, although it is more favourable for the purpose; any polished surface will suffice, provided it receives the rays at a large angle of incidence: it can be seen very well by reflection from one of the faces of a prism, and a singular effect is produced by a particular adjustment of the prism, by which two images of the same object may be conveyed to the eye within a short distance of each other; one is the regular refracted and transmitted image, and the other a reflexion from one of the *internal* faces of the prism: one of these images will be convex, and the other concave, and their juxtaposition forms a very remarkable appearance—one being prismatically coloured and *convex*, and the other of its natural colour and *concave*.

If the student in optics carefully considers the law that "the angles of incidence and reflection are always equal," and will carry out that principle to it fullest extent, he will find that every one of the phenomena of which we have been treating depends solely on the operation of that law; if he considers the position of the source of illumination, the degree of curvature of the surface on which any ray falls, and the angle at which the eye re-

ceives the reflection, he can clearly show that that law determines what part of the object will appear bright and what part shaded.

The same law determines the production of another phenomenon, as remarkable and much more beautiful than the former; if we take a plate of looking-glass, and sprinkle a few grains of dust upon it, and view it perpendicularly with one eye at a few inches distance, the dust appears arranged in a most beautiful radiating star; of which the eye is the centre; it matters not how unequally it is scattered; the symmetry is invariable.

Now in such a case as this, before we begin to *theorize*, it is proper to extend the experiment to other objects, and in accordance with this, it will be found that if the object be a polished surface of steel, of silver, of mercury, or any substance but silvered glass, no such radiating appearance presents itself; if now the student reverts to the law above alluded to, he will at once detect the cause; when the dust is scattered on the surface of silvered glass, an image of each little particle is reflected from the *mercurial surface* through the glass again to the eye; as the angle at which we view any particle increases, so must the apparent distance between it and its image increase, until we arrive at 45°, which gives the maximum of distance.

Now the particle and its reflected image are in the same vertical plane which passes through the eye and the image of the eye; the particle, its image, and the image of the pupil of the eye appear, therefore, to be in the same right line, and as the same applies to every particle, as the line which joins the particle and its image would pass, if produced, through the image of the pupil of the eye, wherever the particle be placed, the pupil appears to be a nucleus or centre from which all these double images extend radially outwards.

When, however, a polished metal is used, there is no reflecting surface from which a *second* image can be obtained, and we therefore see the particles themselves, unaccompanied by any reflected image, and the symmetrical appearance is not then produced. The employment of a concave mirror affords an excellent proof that this beautiful radiating appearance is the effect of reflection. If we hold the eye at the focus of the mirror—that is, at the centre of the sphere of which the mirror is a section,—we see none of these radial lines, but as we approach near to the mirror, they gradually develop themselves; this arises from the circumstance, that when the eye is at the centre of the sphericity, incidence and reflection are both perpendicular to the mirror, or rather, the reflected image is concealed by the particle itself, and therefore cannot reach the eye; but when we approach nearer, the images of the *lateral* particles becomes visible, and the starry effect begins to appear.

In a *convex* mirror, the effect is very beautiful, on account of the increased obliquity which its curvature gives to the incident ray, and the non-existence of a focal point in front of the mirror.

The effect is greatly heightened by mixing powders of two different colours—red and green, or blue and orange, for instance,—as those colours which are complementary to each other produce a singularly pleasing effect by their juxtaposition. A very slight sprinkling of milk, or any coloured liquid, likewise produces this symmetrical effect.

Instead of using glass, we may use two fluids of different densities and different refractive powers, but the two which best answer the purpose are water and mercury; if a little powder be sprinkled on the water, it will be reflected from the mercury under the water, and the same effect produced as with glass, but the latter is the more convenient of the two.

If the eye be directed to one *corner* of the glass, the particles will have the appearance of an expanded fan, emanating from that corner.

Thus may the same simple law be brought to bear upon the whole of the appearances which we have now detailed: in all these instances an object, or an assemblage of objects, *appear* to be what they are not, simply from our neglecting to seek for an explanation from the only sources to which we should apply in such cases, viz. the unerring laws of Nature, the simplicity of which is as conspicuous as their beauty and their universal application.

T.

Mag. Pop. Sci.

A New Anemometer.

At the late meeting of the British Association at Liverpool, Mr. Osler, of Birmingham, read an account of a new Registering Anemometer and Rain Gauge, now in use at the Philosophical Institution at Birmingham, illustrated by diagrams, giving a condensed view of the observations recorded during the first eight months in the year 1837.

In this instrument the direction of the wind is obtained by means of the vane attached to the rod, or rather tube that carries it, and consequently causes the latter to move with itself. At the lower extremity of this tube is a small pinion working in a rack, which slides backwards and forwards as the wind moves the vane, and to this rack a pencil is attached, which marks the direction of the wind on a paper ruled with the cardinal points, and so adjusted as to progress at the rate of one inch per hour by means of a clock. The force is at the same time ascertained by a plate one foot square, placed at right angles to the vane, supported by two light bars running on friction rollers, and communicating with a spiral spring in such a way that the plate cannot be effected by the wind's pressure, without constantly acting on this spring, and communicating the quantum of its action by a light wire, passing down the centre of the tube to another pencil, below which it thus registers its degree of force. The rain is registered at the same time by its weight acting on a balance, which moves in proportion to the quantity falling, and has also a pencil attached to it recording the result. The receiver is so arranged as to discharge every quarter of an inch that falls, when the pencil again stands at zero.

Mr. Whewell spoke highly of the construction of this anemometer; he had no doubt but that a very slight modification of the mode of registering its indications would cause it to answer every purpose which he had lately described as desirable. In its present form, however, it was the force of the aërial current, which it indicated, not the integral effect. He also highly commended the rain-guage, and the method of showing in one diagram to the eye so many important meteorological phenomena. Professor Lloyd stated, there was a very simple method of causing the anemometer of Mr. Osler to give the integral effect of the wind, and that was to cut out the paper covered by the tracings of the pencil indicating the force of the wind, and to weigh it; for it was easy to perceive, that since the ordinates of the curved spaces covered by those tracings were proportional to the force, and, therefore, the velocity of the wind, and the abscissæ to the time, the areas represented the integrals, or the total amount of the aërial current.—Mr. Ettrick asked, whether some other method of supporting the cylinder which

moved backward and forward as the force of the wind varied, rather than friction rollers, would not be desirable—such, for instance, as bridle rods, or other means known to practical mechanics, and he was sure, well known to Mr. Osler. Mr. Osler replied, that many methods of supporting this part of the apparatus had been tried and laid aside, as not answering; among the rest, bridle rods. Mech. Mag.

Simultaneous Meteorology. No. III.

It is earnestly to be hoped that the periodical Hourly Meteorological Observations, suggested by Sir John Herschel, may be universally made, and that with the most scrupulous fidelity and accuracy. An abundant harvest of precious facts will soon present itself to students of meteorology.

One instance of the innumerable and deeply-interesting comparisons, which may be made by means of these series, has been furnished us by a correspondent.

The tables annexed have been drawn up from observations which were made at the March-Equinox of this year, and since published in this or other scientific journals. They contain the more remarkable meteorological circumstances which occurred at two places in different quarters of the world, lying on different sides of the equator, and about six thousand miles asunder; viz., Blackheath in Europe, and Feldhausen in Africa. They also exhibit the atmospheric phenomena which existed at the same instant of time in these two widely-distant spots. When this shall be done in every region of the earth and sea, meteorology will possess a million-eyed Argus, whose watchings will four times every year, detect and expose the similitudes or differences in the physical condition of the atmosphere of a world.

We abstain from indicating results, and pursuing reflections, which an examination of these tables naturally elicits and suggests, because, at present, the meteorological reports do not all of them posses sufficient data for a satisfactory comparison, and have not all been subjected to those processes of reduction which are necessary for such a purpose. In the present case, for example, the European observations of the barometer are not reduced to 32° Fahr., as are the African ones; nor is the difference of level of the two stations given, &c. Still they are sufficient to show that, at the period in question, the pressure at the two places was almost identically the same,—that the temperature was extremely different,—that its range was remarkably greater at Feldhausen than at Blackheath, &c.

No. I.

TABLE of the maximum and minimum Pressure and Temperature of the Atmosphere during the Hourly Series of Observations for the March-Equinox, 1837, made by Mr. J. H. Belville, at Blackheath Road, near Greenwich; to which are annexed the Pressure and Temperature at the same instants of time at Feldhausen, near Wynberg, Cape of Good Hope.

BAROMETER.

Blackheath Road.	Time.		Feldhausen. Corresponding Instant.		Diff. at the same Inst.	Place where the mer. col. was highest
in.	h. m.				in.	
Max. 39·971	VI. 0 A. M.	21 Mar.	VII. 13½ A. M.	21 Mar	0.247	Blackheath Rd.
Min. 29.796	IV. 0 A. M.	22 —	V. 13½ A. M.	22 —	0.004	Blackheath Rd.
	V. 0 A. M.	22 —	VI. 13½ A. M.	22 —	0·006	Feldhausen.
Diff. 0.175						

THERMOMETER.

	Blackheath Road.	Time.		Feldhausen. Corresponding Instant.		Diff. at the same Inst.	Place where the mer. col. was highest.
Interior.	°	h. m.				°	
		XI. 0 P. M.	21 Mar	O. 13½ A. M.	22 Mar	27.0	Feldhausen.
		XII. 0 P. M.	21 Mar	I. 13½ A. M.	22 —	27.0	Feldhausen.
		I. 0 A. M.		II. 13½ A. M.	22 —	27 0	Feldhausen.
		II. 0 A. M.		III. 13½ A. M.	22 —	26.8	Feldhausen.
	Max. 43.0	III. 0 A. M.		IV. 13½ A. M.	22 —	26.8	Feldhausen.
		IV. 0 A. M.	22 Mar	V. 13½ A. M.	22 —	27.0	Feldhausen.
		I. 0 P. M.		II. 13½ P. M.	22 —	27.0	Feldhausen.
		II. 0 P. M.		III. 13½ P. M.	22 —	27.0	Feldhausen.
		III. 0 P. M.		IV. 13½ P. M.	22 —	27.0	Feldhausen.
	Min. 35.0	X. 0 A. M.	21 Mar	XI. 13½ A. M.	21 —	35.0	Feldhausen.
		XI. 0 A. M.	21 Mar	O. 13½ P. M.	21 —	35.0	Feldhauson.
	Diff. 8.0						
Exterior.	Max. 38.4	XII. 0 NOON	22 Mar	I. 13½ P. M.	22 —	37.4	Feldhausen.
	Min. 24.2	VI. 0 A. M.	21 Mar	VII. 13½ A. M.	21 —	42.8	Feldhausen.
	Diff. 14.2						

No. II.

TABLE of the maximum and minimum Pressure and Temperature of the Atmosphere during the Hourly Series of Observations for the March-Equinox, 1837, made by Sir John Herschel, at Feldhausen, near Wynberg, Cape of Good Hope; to which are annexed the Pressure and Temperature at the same instants of time at Mr. Belville's Meteorological Observatory, Blackheath Road, near Greenwich.

BAROMETER.

	Feldhausen.			Blackheath Road.			Diff. at the same Inst.	Place where the mer. col. was highest.
		Time.		Corresponding Instant.				
	in.	h. m.		h. m.		in.	in.	
Max.	29.844	IX. 0 A. M.	22 Mar	VII. 46½ A. M.	22 Mar	29.836	0.008	Feldhausen.
Min.	29.705	I. 0 P. M.	21 Mar	XI. 46½ A. M.	21 Mar	29.892	0.187	Blackheath Rd.
Diff.	0.139							

THERMOMETER.

		Feldhausen.			Blackheath Road.			Diff. at the same Inst.	Place where the mer. col. was highest.
			Time.		Corresponding Instant.				
Interior.		°	h. m.		h. m.		°	°	
	Max.	71.0	II. 0 P. M.	21 Mar	O. 46½ P. M.	21 Mar	36.0	35.0	Feldhausen.
	Min.	69.0	VIII. 0 P. M.	21 Mar	VI. 45½ P. M.	21 Mar	38.0	31.0	Feldhausen.
	Diff.	2.0							
Exterior.	DRY.								
	Max.	92.5	II. 0 P. M.	21 Mar	O. 46½ P. M.	21 Mar	31.1	61.4	Feldhausen.
	Min.	54.5	I. 0 A. M.	22 Mar	XI. 46½ P. M.	21 Mar	28.7	25.8	Feldhausen.
	Diff.	38.0							
	WET.								
	Max.	65.6	VIII. 0 A. M.	21 Mar	VI. 46½ A. M.	21 Mar	not	observed.	Feldhausen.
	Min.	51.3	I. 0 A. M.	22 Mar	XI. 46½ P. M.	21 Mar	not	observed.	Feldhausen.
	Diff	1.47							

Mag. Pop. Sci.

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*On the Yellow Colour of leaves in Autumn, by Berzelius.**

Various researches have been made upon the colours which the Autumnal foliage assumes, after a few frosty nights. Macaire Princeps concludes from his experiments that the leaves having ceased to disengage oxygen, absorb this gas from the air and form an acid, which

*Translated for this Journal by J. Griscom.

changes their colour first to yellow and then to red, and that this acid can be neutralized by an alkali and the green colour restored. He regards these changes as modifications of one and the same colouring matter which he calls *chromule*, and asserts that it is the cause of the common yellow or red colour of the petals. These results are very erroneous. A leaf does not become green by any reagent; but when the foliage has become red, potash will change it to green, because the red colouring matter forms green compounds with that alkali.

Berzelius experiments chiefly upon the leaves of the Pyrus communis gathered in a fresh state, after the colour had turned to a citron yellow. The leaves were maserated in successive portions of alcohol, and also treated with boiling alcohol. The latter became gelatinous on cooling. A granular substance was thus obtained, which had a tendency to crystallization, and also a yellow, soft, fatty substance which appeared identical with the grains. These contained the yellow colouring matter of the leaves, which is described as a yellow, fatty, unctuous substance, easily melted, and then on cooling becoming concrete, transparent, of a brownish yellow, decomposable by heat, and leaving a residuum of charcoal. When moistened with water and long exposed to air and light, it loses its colour completely and is transformed into a greasy matter, which is regarded by Berzelius as a peculiar substance, intermediate between fat oils and resins. He names it *Xanthophylle* (yellow leaves,) and is of opinion that the transformation of the green colouring matter of the leaf into a yellow, is effected by a change in the organization of the leaf produced by frost which modifies the organization. Every effort to reproduce the green from the yellow proved fruitless, nor could he succeed in changing the colouring matter to yellow. The brown colour of the foliage has nothing in common with the yellow. It is produced by an extractive principle first colourless, and which, after the disorganization of the epidemics of the leaf, becomes brown by the action of oxygen, and communicates to the fibrous skeleton of the leaf a brown colour which cannot be removed by a weak solution of caustic potash, or destroyed by sulphurated hydrogen.

The colouring matter of red leaves, Berzelius considers as probably identical with that of red fruits. He examined more particularly that of the leaves of the cherry and of the red gooseberry. It was extracted from the leaves by alcohol, after distillation was separated by the filtre from a resin and a fatty precipitate. The red matter after filtration was thrown down by neutral acetate of lead, of a beautiful grass green, which soon become a greyish brown.

The red colouring matter of the leaves, he names Erythrophylle (red foliage.) When precipitated in parts by lime water, it subsides of green colour while the fluid a paler red tint,—hence this colouring matter is not originally blue. Jour. de Pharmacie Juilliet 183 .

Progress of Civil Engineering.

Construction of Railways.

The Llanelly Railway and Dock Company are adopting a new mode of constructing the upper works of railways, under a patent granted to Mr. Thomas Parkin, who has delivered several lectures upon the subject in London.

As the subject of railways is generally interesting, and must be especially so to the inhabitants of this part of South Wales, which, through the advancement in science, seems destined to become, at no distant period, a very important seat for the manufacture of iron, we shall not hesitate to give a particular description of Mr. Parkin's plan. The road, being prepared of longitudinal bearers of *Kyanized* oak, or other hard wood, from four to six inches in the base, two at the top, or four or five feet deep, dovetailed into one another, thus forming a continuous line, with uprights, twelve inches long and about three in diameter, screwed firmly at every yard into their bottom, are fixed, at a proper height and level, in trenches dug in the road, from eighteen inches to two feet wide and deep. The trenches are then filled with concrete, composed of gravel, sand, and Aberthaw lime, in proper proportions, when only the top of the bearers is visible on the surface of the road, all the rest being completely buried in and consolidated with the concrete, which immediately sets and hardens, and in a short time becomes a solid rock, the whole length of the road forming, as an engineer who inspected the work said, "an everlasting railway." The foundation being complete, patent felt is laid upon the top of the bearers whereto bars of iron, two inches wide, and half an inch thick, are firmly screwed, and the road is finished. The dimensions of the trenches must be regulated by the nature of the soil on which the railway is made, while the parties adopting the plan may use wood and iron of any size they think proper. The rails, as at present fixed in iron chairs, mounted on stone blocks, at every yard, form unyielding points of support, and intermediate flexible spaces. The carriages, of necessity, alternately descend below, and rise above, the mean line of progression, and produce concussions on those points, the severity of which is according to the degree of variation from a straight line and the *rapidity* of the motion. At a speed of twenty-five miles per hour, they would occur 733 times in a minute. On the Manchester and Liverpool line, Professor Barlow "found the whole road to tremble;" and the deflection in the rails so great as materially to diminish their strength, in consequence of their being *permanently* fixed to the chairs.

Upon Mr. Parkin's plan, no vibration, of the *least possible* degree, is felt, the bars being screwed to *continuous* wooden bearers, bedded upon an unyielding mass of concrete, of the strength and durability of which cement the Roman roads are irrefragible evidence. Besides, the patent felt, between the iron and the wood is a non-conductor of vibration, and aids in lessening the tremulous motion attendant on carriages running even on a perfect plane. The stone blocks in the ordinary mode of construction, being insulated and independent of each other, the preservation of a level surface (even if its attainment were practicable) and of parrallelism in the rails, is impossible, as differences in the subsoil must occur; and when a block has sunk, in ever so trifling a degree, below those next it, the next will either remain in the permanent flexure, or be loosened from the chair, or loosen the chair from the block, or hold the block in suspension. The rails and chairs form a series of levers and fulcra, the action and re-action of which are incompatible with permanent stability.

Upon Mr. Parkin's plan, an even surface and parrallel lines may be had, with almost mathematical exactitude, which neither the magnitude of the weights passing on the rails, nor the rapidity of their motion, can disturb, after the concrete has acquired a proper degree of hardness. When a block on one side of an ordinary railway has sunk only in a slight degree, while the corresponding one opposite obtains its position, increased weight

will, of necessity, be thrown on the former, and its tendency to sink still further as well as to be forced out of a parallel line be augmented, in the ratio of the sinking. But with Mr. Parkin's rails no such sinking could be anticipated, even were its occurrence possible.

With level parallel rails, scarcely any lateral pressure can be felt, except in curves, where means will be employed to meet the exigency of the case. The absence of a plane and of parallelism in the rails, is the principal, if not the only, cause of lateral pressure, which could do no injury to Mr. Parkin's road, unless it either removed out of its place one-half of the mass of concrete in which the bearers, with uprights a foot long at every yard, are buried—made a breach in the continuous line of bearers—forced the strong iron screws, by which the bars are secured to the bearers, from their hold, or burst the bars themselves asunder. As these bars are only half an inch wide, and are thus secured to continuous bearers, they present no leverage for the flanch of the wheel to act on, when any lateral pressure takes place; whereas in ordinary railways, the leverage is considerable (the wheels being elevated the height of the rail, which is four or five inches above the point of support,) and produces a corresponding tendency to force the blocks out of a straight line. Upon such an unyielding plane as Mr. Parkin's railway presents, less tractive power, as Professor Barlow has ably demonstrated, is necessary than on rails which deflect between the points of support, while the wear and tear of carriages and engines, and the necessity for limiting their weight, are materially lessened.

A locomotive engine weighs from ten to twelve tons, and subjects the rails to the process of a species of rolling, when they split, and become only of the value of old iron. To such an extent was this the case on the Manchester line, that after five or six years it became necessary to have new ones. The less the vibration and concussion, the less liable are the rails to receive this injury, especially when supported on the softer substances of felt and wood. Moreover, as Mr. Parkin's bars only weigh ten pounds per yard, instead of sixty or seventy, the loss from such injury will be proportionably less. Mr. Parkin's plan may be executed cheaper, even where stone blocks cost little, than any other, and with astonishing rapidity. In most parts the saving, by its adoption, will be fully one half. It may be applied to colleries and private works, especially in Wales, on very advantageous terms. We understand the plan has been recommended by Mr. Brunel for adoption by the directors of the Great Western Railway.—*Cambrian.*

Mining Journal.

Consumption of Coal in Great Britain.

The quantity of iron annually produced in Great Britain may be taken at 700,000 tons; and the quantity of coal required, at an average, to produce each ton of iron, including that used by engines, &c. may be estimated at 5½ tons; giving a total of 3,860,000 tons consumed in the making of iron. According to Mr. Kennedy, the quantity of coal consumed in the cotton manufacture, in 1817, was upwards of 500,000 tons, and the manufacture has since more than doubled; so that, allowing for greater economy, we may fairly estimate the consumption of coal in the cotton trade at 800,000 tons a year. Its consumption in the woollen, linen, and silk trades cannot be less than 500,000 tons. The smelting of copper ores of Cornwall consume annually about 250,000 or 300,000 tons; and it is supposed that the brass and copper manufactures require nearly as much. In the salt works of Che-

shire, Worcestershire, &c. the consumption is probably not under, if it do not exceed, 300,000 tons. The consumption in lime works may, it is believed, be estimated at 500,000 tons. It would appear, therefore, that the total annual consumption of coal in Great Britain may be moderately estimated as follows:—

	Tons.
Domestic consumption, and smaller manufactures	15,000,000
Production of pig and bar iron	3,850,000
Cotton manufacture	800,000
Woollen, linen, silk, &c.	500,000
Copper smelting, brass manufactures, &c.	450,000
Salt-works	300,000
Lime-works	500,000
	21,350,000
Exports to Ireland	750,000
Ditto to colonies and foreign parts	600,000
Total	22,700,000

If we suppose that the above sum of 22,700,000 tons costs the consumer, on an average, 7*s.* a ton, it will be worth, in all, £7,955,000 a year!—*M'Culloch's account of the British Empire.* Mech. Mag.

Deakin's Improved Blast Furnace for Smelting Iron Ore, &c.

In the pretent method of filling blast furnaces, the whole of the materials for making iron, namely, coal or coke, mine, limestone, &c., are put in at the top of the furnace. On this improved plan, the mine and limestone, will, at first, still be put in there; but when the furnace works in a certain state, a part of the mine will be put into it at the flues; and also the greater part of the fuel used for smelting the iron. If pipes are used they may be carried up on the outside of the stack of the furnaces, and may be applied to any blast furnace now in work at a small expense. When this plan is adopted on a furnace being repaired, or newly built, the chimney flue should be carried up in the furnace stack. The coal, or coke being put into the furnace mixed with limestone, mine, scroffula, and rubbish, however free, such coal or coke may itself be, when put in, at present, it must become impregnated with the filth that accompanies it, as soon as the heat begins to act; and it is, moreover, consumed before it comes down to the boshes, and consequently, the power of the fuel is destroyed, before it arrives at the part of the furnace where it is wanted to smelt the mine; but by putting the fuel into the furnace, it will meet the blast in the proper place, free from impurities, and in full strength to melt the materials above it. Better iron will thus be made, with a smaller quantity of fuel, than is done by the present method of filling blast furnaces. Ibid.

Mechanics' Register.

Hot Blast.

"A Founder" in the London Mining Journal objects to the "Patent Hot Blast" that the pig-iron is sadly deficient in point of strength, compared with pig-iron made in the *good old way;* that a cupola man can (seemingly

with ease) take up a No. 1 "Patent Hot Blast" foundry pig, and break it across his knee; that in charging for a casting of five tons weight, for instance, we find it necessary to charge with six tons, whereas five tons twelve and a half cwt. of cold blast pig used to be quite sufficient; that all the founders have been obliged to increase the size of all patterns for castings that are likely to be subjected to much torsion or friction, since the use of the patent has become general in this country. That it has been a valuable discovery to the patentees and iron masters can never be doubted. But it still remains to be shown where and how the public have been benefitted by the invention. And he enquires what has become of the *obdurate toughness* of the genuine Scottish cold-blast pigs.

Another correspondent states that the pig iron obtained from the use of anthracite coal, by Crane's process, is not at all weakened by hot blast, but is better calculated for the founder's use than any he had seen,—that beams cast from this iron of the same pattern with others from coke iron No. 1 had twenty per cent. the advantage. The reason, he says, why pig-iron smelted with anthracite is not weakened by the hot blast is the great quantity of carbon it contains. It is put into the furnace as it comes from the mine (not being cokeable) and being of a ponderous and compact nature, the cold blast could not penetrate as in the case of coke or charcoal.

G.

Patent Spring Folding Hat.

A new hat has lately been introduced into London from Edinburgh, to which it was imported from Paris, which is composed of a skeleton of highly tempered steel springs, extended by an internal metallic ring. It is covered with felt or silk, and may be formed into any fashionable shape, may be compressed into a very small compass, and instantly restored to its original form. *Open* and placed on the head, it resembles other hats, and is equally pleasant to wear; *shut*, it is reduced to the thickness of an inch and a half, when it may be carried under the arm, put between the coat and the vest, like a portfolio, and will only occupy the room of a shirt in a portmanteau. Its exceedingly simple mechanism may be adapted to various forms, while its durability is declared to be equal to that of any other hat: thus, for the convenience of travelling and attending crowded assemblies, this invention must be very useful. When the hat is to be put on, the metallic ring, which is covered with the lining, is pushed towards the inside of the hat; then the edges of the ring slide along the springs, forcing them and the outside covering to its proper form; in which, by means of a notch in the ring, it remains extended. When it is wished to compress the hat, two of the springs must be pressed with the thumb, which make the crown come down and reduce the hat to its compressed state. Mech. Mag.

Locomotives on Towing-Paths.

An experiment, strongly marking the onward spirit of our countrymen, was made on a Scotch canal, in the latter part of the month, which has just expired. Mr. T. Graham, the great patron of rapid travelling by canals, has induced a canal-company of which he is a member, to attempt the substitution of a locomotive engine for the horses by which their rapid boats were drawn. The experiment was made under the direction and personal superintendence of Mr. Macneil, the civil

engineer. The result was of the most promising kind. The boats were drawn eight to ten miles under very unfavourable circumstances, and it was the opinion of several experienced practical men present, that there appeared no reason why eighteen miles should not be accomplished, when a little more practice has familiarized the apparatus, and the roads, &c., should be properly prepared to receive it.

Mag. Pop. Science.

Lunar Occultations for February 1838.

There are no occultations of stars to the sixth magnitude inclusive, visible in Philadelphia, in the month of February 1838.

Meteorological Observations for September, 1837.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches.	Inches.			Inches.	
	1	50°	66°	29.85	29.95	W.	Moderate.		Clear—do.
	2	54	67	90	80	NE.	do.		Cloudy—Clear.
	3	56	69	90	30.00	W.	do.		Clear—do.
	4	50	69	30.25	15	W.	do.		Clear—do.
	5	52	70	30	30	W.	do.		Clear—partially cloudy.
	6	55	70	30	20	S.	do.		Clear—do.
☾	7	60	69	10	11	S.SW.	do.		Cloudy—do.
	8	63	70	29.90	29.90	W.	do.	1.35	Rain—do.
	9	60	72	90	95	W.	do.		Clear—do
	10	66	76	94	90	E.SE.	do.		Cloudy—do.
	11	69	78	80	70	W.	do.	.14	Cloudy—do.—rain.
	12	61	66	65	65	W.	Brisk.		Clear—flying clouds.
	13	48	66	85	90	NW.	Moderate		Clear—do.
♁	14	46	66	95	30.00	E.	do.		Clear—do.
	15	51	65	30.05	5	N.	Brisk.		Clear—partially cloudy.
	16	49	62	5	6	NE.	Moderate.		Clear—cloudy.
	17	56	72	29.95	29.90	NE.	do.		Partially cloudy—clear.
	18	56	74	75	75	NE.SW.	do.		Clear—do.
	19	58	66	85	85	W.	Brisk.		Cloudy—clear.
	20	50	65	30.06	30.15	W.	do		Clear—do
☽	21	47	64	2	25	W.SE.	do.		Clear—do.
	22	50	66	20	6	NE.W.	do.		Partially cloudy—do. do.
	23	50	63	6	12	W.	do.		Clear—do.
	24	45	62	35	35	E.	Moderate		Clear—do.
	25	42	67	25	20	W.SW.	do		Clear—do.
	26	55	74	5	00	W.	do.		Cloudy—clear.
	27	64	66	00	10	E.	do.		Cloudy—do.
	28	60	71	5	29.95	E.S.	do.	.35	Fog—cloudy—rain in night.
⊗	29	65	75	29.90	90	S.	do.		Fog—cloudy.
	30	54	62	90	80	E.	do.	.45	Rain—do.
	Mean	54.73	68.27	30.01	30.00			2.29	

Thermometer.			Barometer.
Maximum height during the month	78.00 on 11th.	. .	30.35 on 24th .
Minimum do. .	42.00 on 25th	. .	29.65 on 12th
Mean do. .	61.50 . .	. .	30.01.

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